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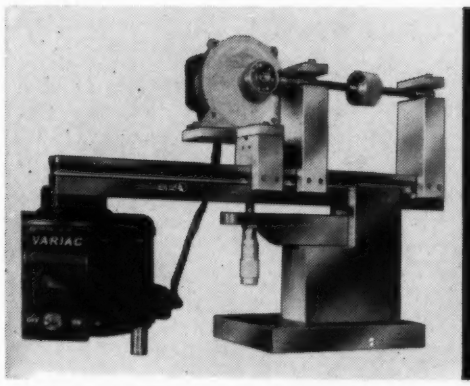
MILITARY AUTOMATION

THE MAGAZINE OF Systems Engineering



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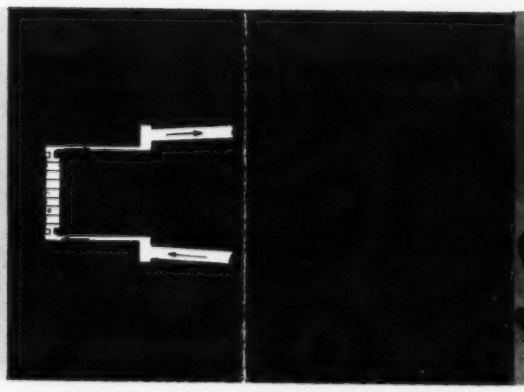

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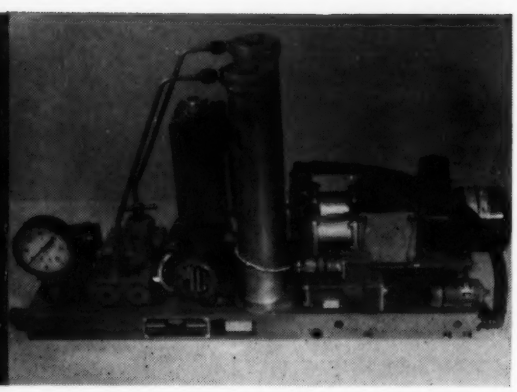

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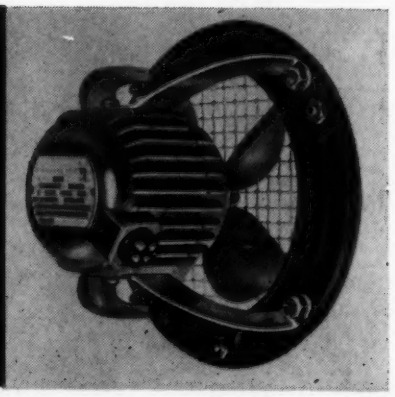

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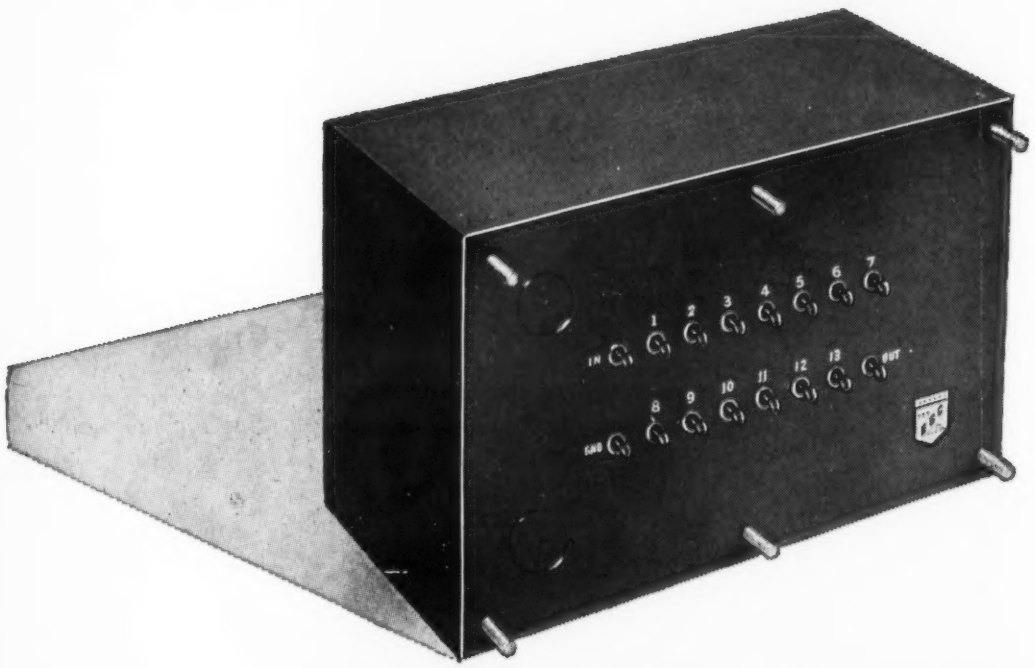

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**J. R. Anderson, "Electrical Delay Lines for Digital Computer Applications" Transactions of the I.R.E.—June, 1953

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MGP4	800	V	318	.175	5.0	3	6.3	8	LB
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MGF5	6.3	2.0	2,500	FB
MGF6	6.3	5.0	2,500	GB
MGF7	6.3	10.0	2,500	JB
MGF8	6.3	20.0	2,500	KB
MGF9	2.5	10.0	10,000	JB
MGF10	5.0	10.0	10,000	KB

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MPT2	V	V		0.25/0.25	0.2-1.0	.004	2	0.7	250
MPT3	V	V		0.5/0.5/0.5	0.2-1.5	.002	3	1.0	250
MPT4	V	V		0.5/0.5	0.2-1.5	.002	2	1.0	250
MPT5	V	V		0.5/0.5/0.5	0.5-2.0	.002	3	1.0	500
MPT6	V	V		0.5/0.5	0.5-2.0	.002	2	1.0	500
MPT7	V	V	V	0.7/0.7/0.7	0.5-1.5	.002	3	1.5	200
MPT8	V	V	V	0.7/0.7	0.5-1.5	.002	2	1.5	200
MPT9	V	V	V	1.0/1.0/1.0	0.7-3.5	.002	3	2.0	200
MPT10	V	V	V	1.0/1.0	0.7-3.5	.002	2	2.0	200
MPT11	V	V	V	1.0/1.0/1.0	1.0-5.0	.002	3	2.0	500
MPT12	V	V	V	0.15/0.15/0.3/0.3	0.2-1.0	.004	4	0.7	700

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Catalog No.	Application	Impedance Prim. Ohms	Impedance Ct.	Impedance Sec. Ohms	Impedance Ct.	DC Current Prim. P.P. Max MA	DC Current Sec. Unbal. MA	Max Level DBM
MGA1	Single or P.P. Plates — to Single or P.P. Grids	10K	V	90K Split	V	10	10	+15
MGA2	Line to Voice Coil	600 Split		4, 8, 16		0	0	+33
MGA3	Line to Single or P.P. Grids	600 Split		135K	V	0	0	+15
MGA4	Line to Line	600 Split		600 Split		0	0	+15
MGA5	Single Plate to Line	7.6K 4.8T		600 Split		40	40	+33
MGA6	Single Plate to Voice Coil	7.0K 4.8T		4, 8, 16		40	40	+33
MGA7	Single or P.P. Plates to Line	15K	V	600 Split		10	10	+33
MGA8	P.P. Plates to Line	24K	V	600 Split		10	1	+30
MGA9	P.P. Plates to Line	60K	V	600 Split		10	1	+27

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For more information circle **2** on inquiry card.

MA military automation

VOL. 2, NO. 4
JULY-AUGUST
1958

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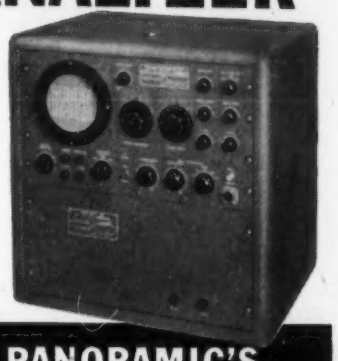

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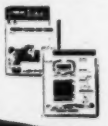

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MA Editorial

MILITARY SYSTEMS ENGINEERING

SYSTEMS requirements are the criteria against which every new idea and product must be tested before it is incorporated into military weapons, communications and logistics. The initial systems concept—in which all electronics and control equipment installed in a single aircraft was mutually compatible, effectively supported the mission of the plane, and lifted the burden of routine operations from the pilot and the crew—has graduated into wider fields and now encompasses weapons systems which include missiles, field and fleet support units, and aircraft. Every new scientific technique and each laboratory discovery must be evaluated to determine its relationship to, and impact on, systems already in being, under development, or envisioned. "Passing the word" on developments of military systems significance was initially recognized as an important facet of the mission of *MILITARY AUTOMATION.*

An example of system-oriented evaluation has been the acceptance of semiconductor devices in the design of light-weight miniaturized devices for missile, airborne and portable military equipment and instruments. Their use in permanently-installed shore and land-based equipment first lagged behind those applications where miniature size, light weight, and low power consumption were most important. However, as advantages of increased reliability, lower cost, and cooler operation are realized, the new-type amplifiers and computing elements are being extended into many other military systems in which the need for miniaturization is not urgent. As military systems engineers become skilled in the use of semi-conductors, all systems under development benefit. Finally, new systems become possible. Telemetering circuits which are now operating in satellites would have been impracticable prior to the advent of the transistor and solar cells, both semi-conductor devices.

Better military systems are the result of teamwork between specialists. The good development team includes mechanical, human factors, production, environmental test and maintenance engineers, along with scientists and electronics design personnel. Military technicians who can assess the effectiveness of the system in combat are also present. Each of these specialists needs a basic understanding of all other phases of the system if he is to make his most effective contribution to the team.

Because the staff of *MILITARY AUTOMATION* recognizes its opportunity and obligation to relate new contributions from every branch of the scientific arts to military systems in which they are applicable, we have included the phrase, "The Magazine of Systems Engineering," in our title. As a direct outgrowth of our mission as stated in our first issue and practiced in each issue since that date, this legend does not signify a change, but rather a re-emphasis, in editorial policy.

Major M. F. Behar, USA-Ret.

MAJOR Manoel F. de Mayo Behar, USA-Ret, vice-president of Instruments Publishing Co., Inc., and Consulting Editor of *MILITARY AUTOMATION,* succumbed to a coronary disorder on Aug. 1, 1958, while attending the Gordon Research Conference on Instrumentation at Colby Junior College, New London, N. H. He was 69 years of age, and is survived by his widow, the former Sara Pattin.

Major Behar received his education in France, Switzerland and England; at Pratt Institute (Brooklyn) and Columbia University (New York). As an officer in Army Ordnance during World War I, he invented several military instruments. From 1929 to 1955 he was editor of *INSTRUMENTS* magazine in which capacity he earned world recognition. From 1955 to the day of his death he served as an active Editor Emeritus on the staff of *INSTRUMENTS & AUTOMATION* magazine. He had also served as consulting editor of *MILITARY AUTOMATION* since its inception in January 1957.

Major Behar authored several books and innumerable articles on instrumentation. His serials in *INSTRUMENTS* from 1930 to 1936 constituted the first formulation of the science of Instrumentation, a term proposed initially by him to denote the then unwritten science. His article, "Regulation, Automatic," written in the 1929 edition of the Encyclopaedia Britannica is included in the new 1958 edition without change.

He was active in the formation of the Instrument Society of America, which made him an Honorary Member in 1957. He was also a Fellow of the American Association for the Advancement of Science, Life Member of the American Society of Mechanical Engineers, Charter and Life Member of the Army Ordnance Association, and member of the American Institute of Physics, American Physical Society, American Association of Physics Teachers, American Institute of Electrical Engineers, Federation of Atomic Scientists, and the Institute of Aeronautical Sciences.

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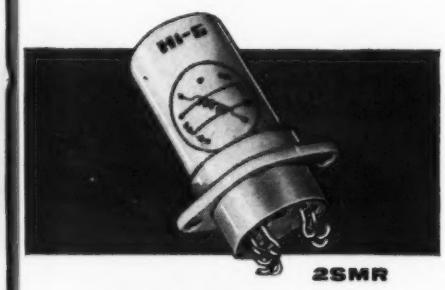

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Subcarrier Oscillators Miniaturized for Missile Telemetering

Transistor techniques are being effectively used to reduce critically needed weight and space in missile telemetering systems. Absolute pressure measurements in flight can now be translated into RDB band frequencies by a cylindrical unit (Fig. 1) less than 2″ dia and 4″ long, designated the AP-33T. A companion unit, the Model A-15T accelerometer having approximately the same dimensions (Fig. 2), provides RDB frequency outputs proportional to accelerations in ranges from 5 to 500 G.

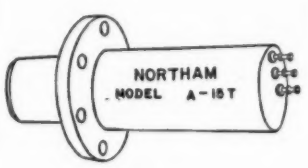


FIG. 1

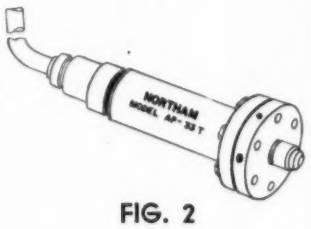


FIG. 2

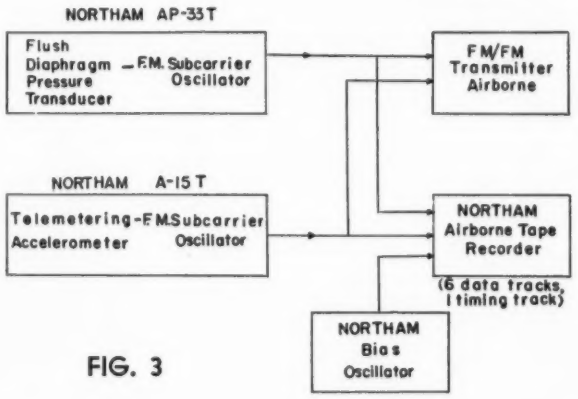


FIG. 3

Application of the new units, developed to be used independently or in combination with other Northam telemetering components, is shown in Fig. 3. The transducer oscillators can be teamed to directly modulate a FM/FM airborne transmitter or alternatively to record on an airborne Northam magnetic tape recorder. Approximately 10 ma, at 24-32v dc, is sufficient power to supply each unit.

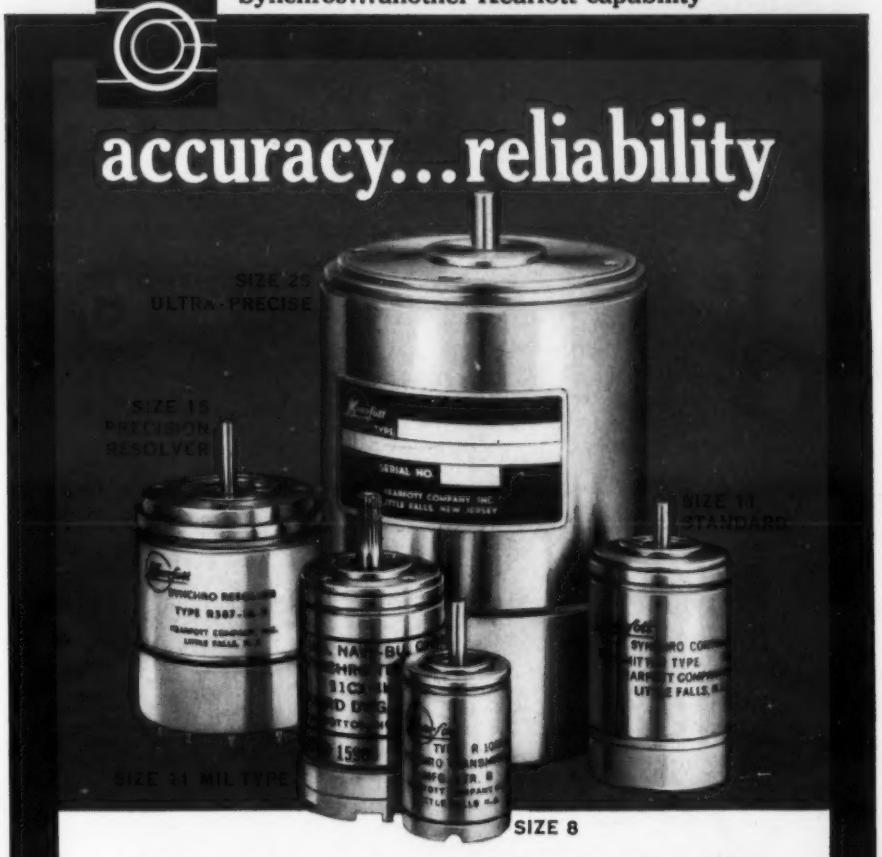
Incorporation of the subcarrier oscillator with the transducer in so miniscule a package greatly simplifies the installation and calibration of the telemetering system. The unitized package is aligned at the factory for the proper response characteristics.

Depending on the intelligence frequency bandwidth required, and the RDB channels which may be used, from two to four data channels may be multiplexed on each data track of the tape recorder selected. If multiplexing is used, a bias oscillator is required; if not, the bias unit is not needed.

The new units are the latest developments in a series of telemetering and recording instruments produced by Northam Electronics, Inc., 2420 N. Lake Ave., Altadena, Calif.

For more information on these units circle **101** on inquiry card.

Synchros...another Kearfott capability



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Kearfott offers the widest range of synchros in the industry. Ruggedly constructed of corrosion-resistant materials, they give unequalled performance under every environmental condition. For best characteristics and reliability, specify Kearfott for all your synchro requirements. Here are a few typical models:

Size 8: .750″ x 1.240″. 1.75 oz. −54C to +125C.
Available as transmitter, control transformer, resolver, and differential. Max. error from EZ: 10, 7 and 5 minutes.

Size 11 Standard: 1.062″x1.766″. 4 oz. −54C to +125C.
Available as transmitter, control transformer, repeater, resolver and differential for 26v and 115v applications. Max. error from EZ: 10,7 and 5 minutes standard, 3 minutes in 4-wire configurations.

Size 11 MIL Type: Dimensions and applications same as above. Meets Bu. Ord. configurations: max. error from EZ: 7 minutes.

Size 15 Precision Resolver (R587):
With compensating network and transistorized booster amplifier, provides 1:1 transformation ratio, 0° phase shift. Max. error from EZ: 5 minutes.

Size 25 Ultra-Precise: 2.478″ x 3.187″. 45 oz.
Available as transmitter, differential, and control transformer. Max. error from EZ: 20 seconds arc.

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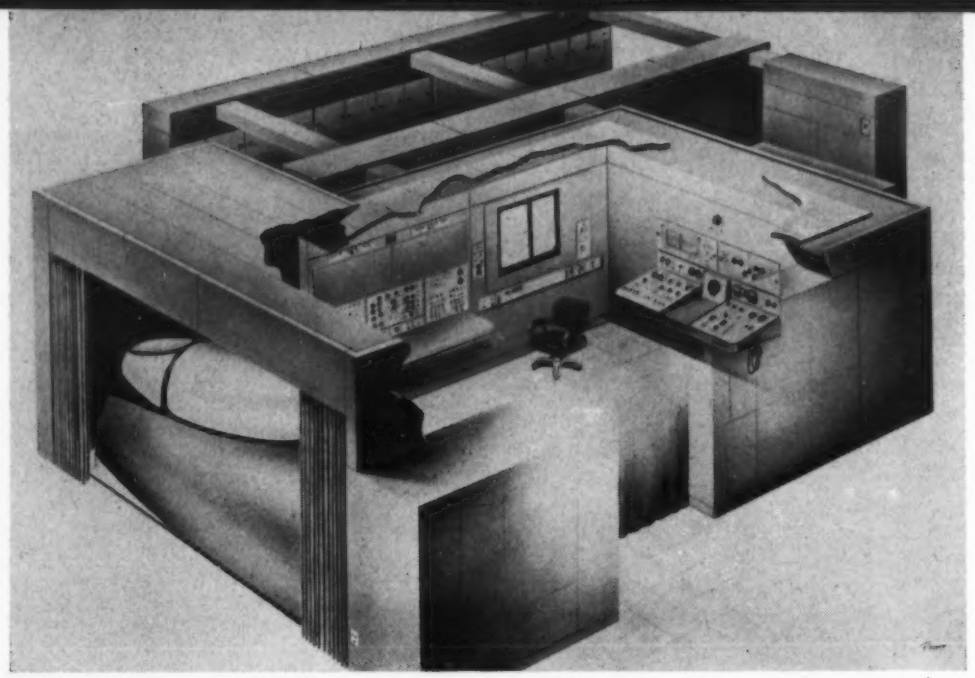

FIG. 1. MELPAR "CENTURY SERIES" jet fighter flight simulator, extensively used by the Air Force to develop and maintain pilot skills, uses Vernistat ac potentiometers to provide an electrical analog corresponding to the relative position of one aircraft with respect to another or to a radio station.

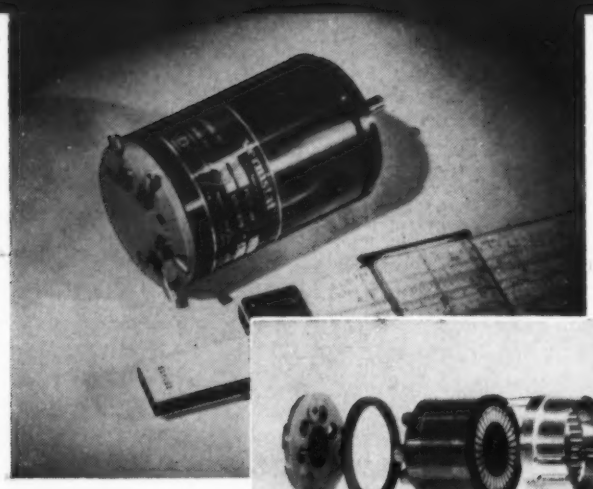

FIG. 2. THE VERNISTAT AC Potentiometer combines autotransformer with one-turn potentiometer.

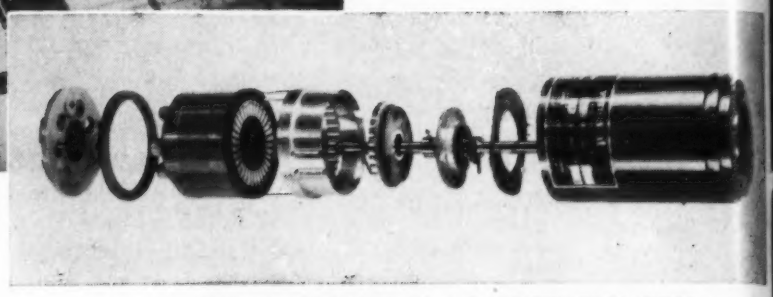

FIG. 3. VERNISTAT AC POTENTIOMETER in exploded view, from left to right: Endcap; bezel; autotransformer-commutator assembly; internal tooth gear; planet-gear, resistance-element assembly; potentiometer-wiper, slip-ring, stop assembly; and outer housing.

New Component Advances Reliability of Jet Trainers

SIMULATION OF AIRCRAFT, radar, and sonar operations in many training courses is proving far superior to the use of the actual equipment. This is particularly evident in the training of pilots for such new high-performance jet planes as the "Century Series" F-101A and F-101B.

The "Century Series" Flight Trainer (Fig. 1), developed by Melpar, Inc. under an Air Force contract, is providing safe and inexpensive pilot training which is so realistic that experienced jet pilots are given regular training schedules with it. By this means, the Air Force is able to exercise the pilot's skill in handling the actual aircraft in emergency situations that are, fortunately, seldom encountered in routine operations. The training, in addition to being safer, is superior in many ways since it can be better supervised and provided to more personnel than would otherwise be possible. Crews, planes, maintenance and overhaul personnel which would be needed if planes alone were used for training are conserved.

Trainers now in service are scheduled for a minimum of maintenance "down time." However, the designers of trainers are faced with special problems in component reliability. To accurately simulate the many interrelated reactions of a transonic jet plane requires hundreds of servo systems with widely varying characteristics, connected together through feedback loops to make the trainer behave like an actual plane. The physical motions of the trainer cockpit, movements of the panel and navigational instruments, engine speed, temperature, and fuel consumption are realistically simuated to duplicate conditions which would be experienced in the actual craft.

The "brain" of each servo loop is a small but highly accurate linear or nonlinear precision potentiometer; hundreds of these are required in each trainer. Nonlinear potentiometers must have their characteristics "hand tailored" to agree with the particular function which each must govern. Although such potentiometers may be made-to-order in production, field repair and adjustment sometimes must be made when the trainers are operating far from a factory which can supply the needed part, or another with modified characteristics. Some manufacturers have supplied tapping kits to enable field engineers to modify standard potentiometers to meet needed function curves. Hand tapping of delicate potentiometer windings is difficult, however, even under the best of conditions. Other factors affecting the reliability of potentiometers used in jet aircraft trainers is their accuracy under continued use, freedom from phase shift, and susceptibility to loading error.

A new approach to potentiometer problems has been made in the Vernistat ac potentiometer developed by the Perkin-Elmer Corporation of Norwalk, Conn. Within the physical dimensions of a size 18 synchro (Fig. 2); a 31-tap autotransformer, a low-resistance toroidal potentiometer, and a unique gear-switch are combined to provide the best features of a precision potentiometer and a variable transformer. The new device circumvents many causes of poor reliability that have previously plagued design and maintenance engineers.

The tapped autotransformer provides basic division of voltage into 30 discreet levels. Interpolation between successive voltage levels is accomplished by a continuous one-turn potentiometer, tapped portions of which are switched sequentially between taps of the autotransformer (Fig. 3). The potentiometer assembly is supported on an eccentric section of the control shaft so that the pinion (external gear) is at all times in mesh at one point with the internal gear. Because there is one tooth less on the pinion, the potentiometer assembly advances one tooth along the internal gear with each rotation of the control shaft, thus commutating the potentiometer taps in sequence along the autotransformer taps and permittting smooth interpolation between the autotransformer taps. Manipulation of the Vernistat is by this means similar to that of a multiturn potentiometer except that the Vernistat can be continuously rotated.

An almost infinite variety of nonlinear output curves can be arranged as desired by non-sequential connection of the autotransformer taps to the commutator segments as shown in Figure 4. Delicate workmanship needed in making fragile connections to high resistance potentiometer windings is not required when "tailoring" a Vernistat potentiometer

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to a nonlinear curve. Interpolation by the potentiometer allows generation of nonlinear curves with 30-chord accuracy, and the conformity that is obtainable obviously varies with the curve. Typically, conformity to a sine function, for example, is ±0.25% from peak to peak.

Input impedance of the Vernistat is high, its value depending on the function. The output impedance is determined primarily by the resistance of the inter-

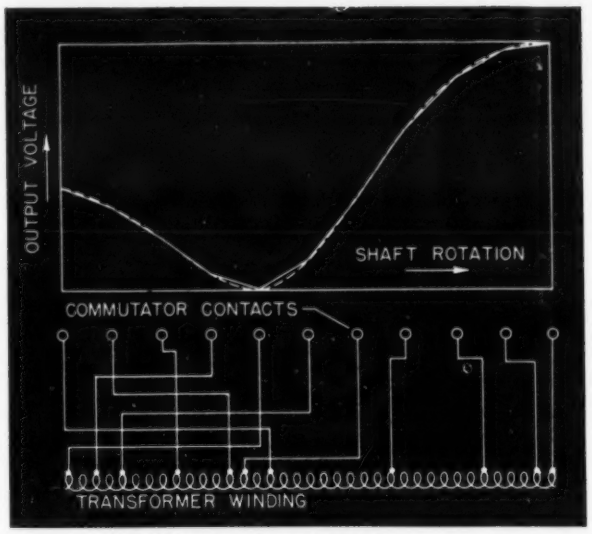


FIG. 4. NON-LINEAR OUTPUTS can be arranged in almost infinite variety, using non-sequential connection of Vernistat autotransformer taps to commutator segments. Potentiometer unit interpolates between taps, generating non-linear curve to 30-chord accuracy as shown in solid line.

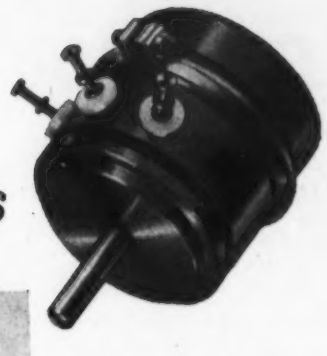
polating potentiometer, and varies from a maximum value of typically 130 ohms when the output wiper is between taps to a very few ohms each time the output wiper passes over a tap. Because of the cyclical nature of the output resistance, calculation of all values of loading error is quite complicated. However, considering the maximum loading error in a hypothetical case involving a 500,000-ohm load on a 50,000-ohm potentiometer, the Vernistat loading error is about 2% of that of a standard resistance potentiometer.

Because the interpolating potentiometer is a low resistance winding, used repeatedly each revolution, it employs wire approximately three times larger than the conventional high-resistance potentiometer. This provides for a longer life and helps maintain linearity. The maximum input voltage of the Vernistat is governed by the saturation voltage; 130 volts at 400 cps, or 20 volts at 60 cps for the standard models.

Other applications which are suggested by the unique characteristics of the Vernistat include: (1) use of low phase shift to eliminate phase compensation schemes and improve servo system accuracy, (2) use of low output impedance to eliminate isolation amplifiers between the potentiometer and load, (3) use of high resolution to permit operation into high-gain amplifiers, and (4) use of high linearity to permit accurate analog computation.

For more information on Vernistats circle **248** on inquiry card.

One pot's answer to tough requirements



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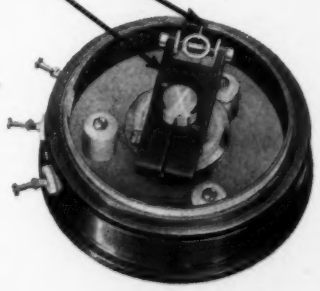

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DRY AIR FOR AVIONICS EQUIPMENT

AIRBORNE AND MISSILE electronic equipment must operate in ambient atmospheres varying between sea level and 80,000 ft altitude and in temperatures from −65°F to 160°F. Under such conditions, electronic equipment spaces tend to "breathe" and to trap moisture, which in turn promote electrical breakdown and changes in dielectric values which can cause frequency shift in components remaining in operating condition. Waveguides and coaxial cables are particularly vulnerable to moisture. With increasing power being applied in airborne and missile applications, dry atmosphere at all times in waveguides is essential.

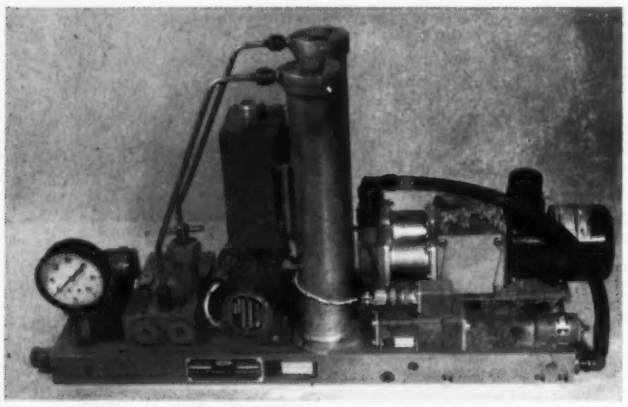


FIG. 1. HEAT-LES dessicant reactivator.

Conventional air dehydrating methods which use heating to re-activate a dessicant have been found inadequate at both high and low extremes of ambient temperature. A new method of dessicant reactivation (designated HEAT-LES) is now available for military applications in a compact packaged unit weighing less than 21 lbs (Fig. 1). It comprises a compressor-dehydrator system with all the components manifolded through the cast aluminum base. Any component thus can be removed for inspection or replacement without disturbing others. The new design is credited by its makers with elimination of fluctuating dewpoints, a 900% reduction of weight, and effluent air of 0.01% relative humidity under all operating conditions. Operating details of the HEAT-LES reactivation techniques are not disclosed.

The flow of air from compressor to drying chambers (Fig 2) is conventional and has been tested at rates to 0.32 SCFM for a period of 500 hours under the conditions and with results shown in Table I. This standard MIL-T-5522 test was performed in an environmental test chamber of 8 cuft minimum, and began with a maximum-temperature, maximum-humidity test of 1 hour. During this period 140°F dry bulb, 125°F wet bulb conditions were maintained in the chamber. Next the conditions were reduced to 110°F dry bulb, 100°F wet bulb, and continuous operation continued for 498 hours.

The third period consisted of operation at −25°F dry bulb, −25°F wet bulb conditions, which was preceded by an 8-hour cold soak period. Dew point of the effluent air was required by the test to be a maximum of −25°F for all stages of the test. Actually, the dewpoint at no time rose above −125°F during the qualification test. A final test consisted of a cold soak at −65°F for 24 hours, after which the equipment was operated for one hour to demonstrate operability of all components. Only MIL qualified components have been used in its construction.

The HEAT-LES method of dessicant reactivation is a development of the Trinity Equipment Corporation of Cortland, N. Y.

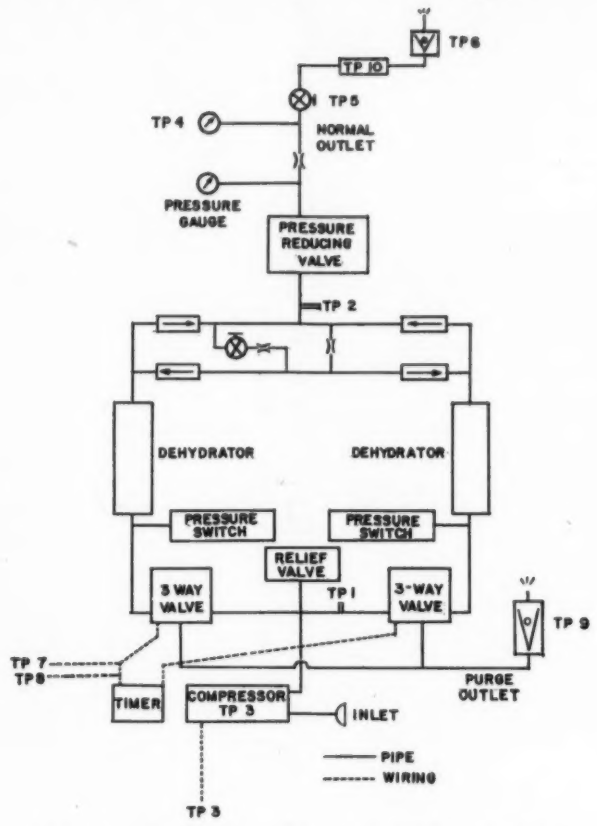


FIG. 2. SYSTEM provides 1.0 SCFM dry air.

TABLE 1. HEAT-LES QUALIFICATION TEST RESULTS IN ACCORDANCE WITH REQUIREMENTS OF MIL-T-5522

Time	Ambient Condition	Remarks	Maximum Dewpoint Allowable
1.0 hour	140°F Dry Bulb 140°F Wet Bulb	Continuous Operation Required.	−25°F
497 hour	110°F Dry Bulb 100°F Wet Bulb	Continuous Operation Required.	−25°F
1.0 hour	−25°F Dry Bulb −25°F Wet Bulb	Continuous Operation Required.	−25°F
Cold soak at −65° for 24 hours and then operate 1.0 hour to assure operability of all components			−65°F

Note: The dewpoint of the effluent air of this equipment at no time rose above −126°F during the qualification testing.

For more information circle **102** on inquiry card.

New Digitalizer Provides Tenth-Minute Resolution

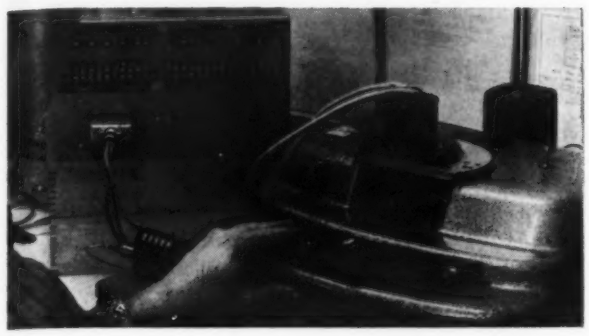
FIG. 1. FIBER-GLASS CODE CYLINDERS, bearing code patterns formed by islands of precious metals, ensure low inertia, high strength, and low capacitance characteristics. Any cyclic or Gray binary code can be generated.

NON-AMBIGUOUS BINARY decimal representation of angular shaft position—a principle widely used in navigational computers, position display, transducer conversion, fire control and other military applications—is accomplished by a new IDL shaft angle converter to a code definition of 216,000-bits for a complete readout. Although the converter occupies less than 10 cubic inches, has a diameter of only 2½" and weighs only 4 oz, its brushes carry up to 20 ma at 40 volts to drive output counters, etc., without amplification.

Each converter comprises a train of five code drums, each of the type shown in Fig. 1. As the first drum is turned through one complete revolution by the input shaft, an intermittent gearing and cam system advances a pin on the second stage code drum every 90° of input shaft rotation. This intermittent gearing and cam system exists between each of the 5 drums. Since 40 digits are contained on the first drum in one revolution, or one digit per each 9° revolution, a total of 5400 revolutions of the input shaft are required to drive the converter through its full range of code positions. Each code bit represents 9° rotation of the input shaft. Conversion from one code position to the next occurs at 6° ±1° within this increment. Fig. 2 shows the converter being tested to determine its angular accuracy throughout its complete range to the nearest tenth of a minute.

The converter can be driven in either direction at speeds to 500 rpm input for more than 500 hours of life with no loss of conversion accuracy in code readout. No diodes are used, high accuracy and free-

dom from excessive brush noise and bounce being guaranteed by the precious metals and accurate workmanship used in its fabrication. Each unit is designed and has been tested to meet the environmental conditions specified in MIL-E-5272A.

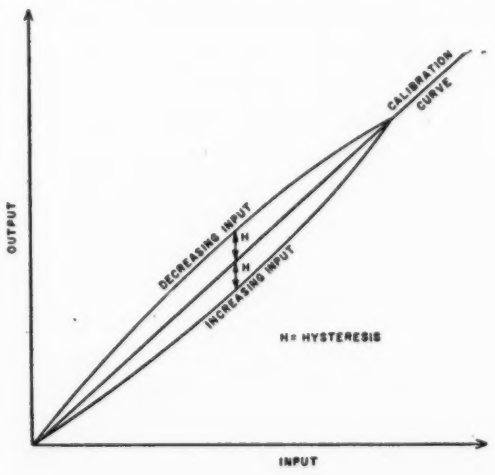


Modifications of this system can include up to 60 individual coding digits on each code drum. Also any cyclic or Gray binary code can be furnished. The use of the Gray code tends to eliminate ambiguity since in this code only one bit changes sign in passing from one digit to the next. Smaller units providing ranges of 1:1000 bits and 1:3600 bits are also available in the same conformation. The IDL shaft angle converter is a development of the Instrument Development Labs., 67 Mechanic St., Attleboro, Mass.

For more information circle **103** on inquiry card.

A Glossary of Temperature and Pressure Measurement

HYSTERESIS—The difference between the output reading for increasing input and the output reading for decreasing input measured at any given point



within the range of an instrument. For the purpose of specifying performance, hysteresis is defined as one-half the difference between curves of output data plotted as a function of increasing and decreasing input. The amount of hysteresis is therefore equivalent to the deviation of the increasing and decreasing output curves from the calibration curve. (*From 20-page illustrated Glossary, Trans-Sonics, Inc., Burlington, Mass.*

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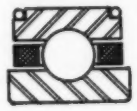
THIN-SECTION INSTRUMENT BEARINGS WITH ONE-PIECE RETAINERS FOR.....



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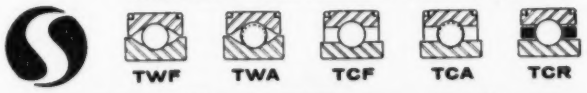

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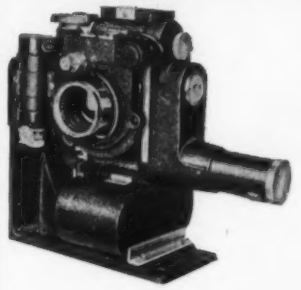

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Input Power (total) 3.8 watts	Input Power (total) 5.6 watts	Generator: Input Voltage 10 v	Output Power 4.0 watts	Linearity .5%	Accuracy 7' error max.	Accuracy 30' max. error spread	Accuracy 7' error max.	Accuracy 7' error max.	Accuracy 7' error max.
Stall Torque .15 oz in min. .20 oz in nom.	Stall Torque .3 oz in min.	Output Voltage 0.13 v/1000 rpm max.	No Load Speed 20,000 rpm	Null E at EZ .015 v	Null 30 mv max.	Torque Gradient 2200 mg-mm/deg.	Null 30 mv max.	Null 30 mv max.	Null 30 mv max.
Max. Weight 29 gms.	No Load Speed 6500 rpm min.		Input Voltage 28 v DC	Phase Shift 15 deg. lead	Phase Shift 8.5 deg. lead	Input Power .54 watts	Phase Shift 8.5 deg. lead	Phase Shift 9 deg. lead	Phase Shift 11 deg. lead

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INTRACIPROCATION-- A Breakthrough in Reducing Bearing Friction

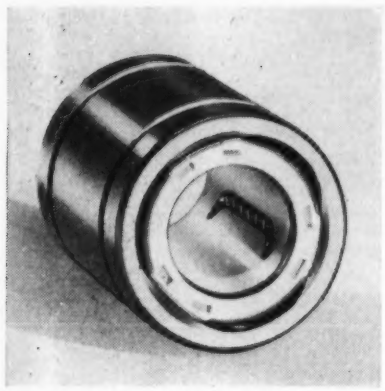

FIG. 1. INSTRUMENT BALL BUSHING (INST 4812) features finest materials and finish, has less than half friction coefficient of the standard Ball Bushing.

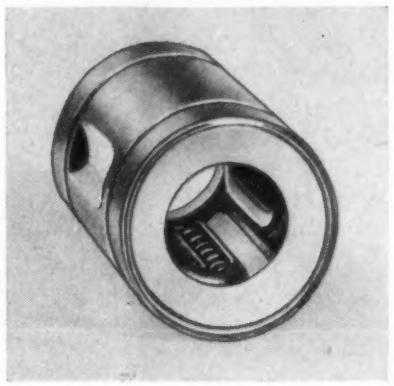

FIG. 2 STANDARD BALL BUSHING allows longitudinal motion of shaft through bushing, is rugged and efficient in all but most sensitive instrument applications.

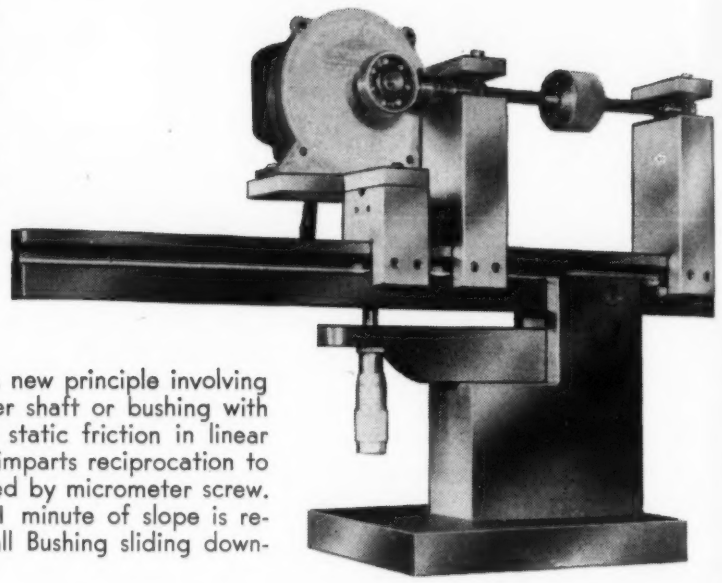

FIG. 3 INTRACIPROCATION, a new principle involving continuous reciprocation of either shaft or bushing with respect to the other, eliminates static friction in linear bearings. Variable speed motor imparts reciprocation to shaft while angle of shaft is varied by micrometer screw. With intraciprocation less than 1 minute of slope is required to start an Instrument Ball Bushing sliding downhill.

A NEW principle, named Intraciprocation, for sharply reducing bearing friction has been discovered by a leading bearing manufacturer while developing a new type of linear instrument bearing. (Linear bearings facilitate endwise, rather than rotational, motion of a shaft.)

As manufacturers of linear ball bearings (Ball Bushings) to reduce "cross coupling" in accelerometers, G-switches and other inertial devices, The Thomson Industries, Inc., Manhasset, N. Y., has worked for several years in improving the performance parameters of these bearings.

The threshold sensitivity which can be achieved by any component using a linear ball bearing can be computed from the angle of the shaft down which the bearing will continuously roll. The factory criterion for testing its latest precision instrument bearing, INST 4812 (Fig. 1), is an angle of 20 minutes or less with a 3 oz weight on the bearing. This remarkable sensitivity was achieved by careful attention to mechanical details. The bearing uses a ball retainer machined from a solid sleeve in which the ball circuits are milled to close tolerances. Also, the load-carrying outer sleeve is ground to close tolerance on both size and finish. Precision ball guidance provided by the accurate mating of the retainer and outer sleeve reduces the amount that the balls can stagger, thus increasing the smoothness of the bearing's operation. The difference in construction between the INST 4812 and the standard Ball Bushing (Fig. 2) is apparent.

Threshold sensitivity of the precision linear bearing is less than half the angle used to test the standard Ball Bushing. However, discovery of the new principle of Intraciprocation has succeeded in eliminating 95% of the remaining friction! This principle consists of reciprocating either the bearing or the shaft through a short stroke at a relatively high frequency while the other member is free to traverse in a linear motion. A magnitude and frequency of reciprocation of one member is selected so that the mass of the other member is not affected by the "mechanical ball activation."

The test rig used in the evaluation of the Intraciprocation principle is shown in Fig. 3. Equipment at hand was used with no attempt made at compactness or portability, but was arranged to investigate various speed and stroke combinations to determine optimum conditions for a given mass. In actual equipment reciprocation can be provided by many light and compact electrical or mechanical techniques, such as solenoids, vibrators, or mechanical linkages.

By applying the principle of Intraciprocation, sensitivities comparable to shaft angles of less than one minute (0.00029 G) become possible. This substantial improvement in bearing characteristics results from a number of factors. In any linear motion, whether it be intermittent or continuous, the bearing elements must periodically come to a dead stop which changes the friction coefficient of the mating parts from a rolling to a static coefficient of friction. The static coefficient of friction is greater than rolling friction and is sometimes called "breakaway friction", Superimposed reciprocation keeps the balls activated at all times, preventing the static condition from occurring.

Other important aspects of Intraciprocation are: (1) The mechanical activation maintains separation of the balls in a "full type" ball circuit reducing the tendency of the balls to rub on each other: (2) any binding or friction caused by a ball of slightly larger diameter over-running a ball ahead is eliminated because the direction of motion is continually changing; (3) hysteresis or poor repeatability of the mechanism caused by minute dirt particles causing unpredictable sticking does not occur as particles are swept aside by the reciprocation; and (4) adverse effects caused by ball irreglarities are minimized by reciprocation.

Another important feature of Intraciprocation is that it enables the position or motion of the supported member to be biased or changed without direct application of force to it. By remote or direct external control, the speed of the reciprocation stroke in one direction can be made to exceed the speed in the other direction, thus creating a controlled unbalance which can be used for inertial guidance or other purposes.

The new principle of Intraciprocation is expected to be carefully studied by scientists and engineers to determine whether its use can (1) improve present devices, or (2) make feasible the development of new components or devices through extreme reduction of bearing friction.

For more information on INST 4812 Ball Bushings circle **249** on inquiry card.

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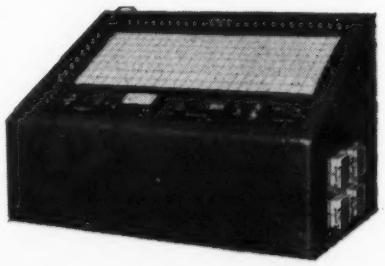

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For more information circle **13** on inquiry card.

Constant Output Speed Drive Accessory

New Lycoming toroid friction drive for aircraft generators developed under contract with the Bureau of Aeronautices, U.S. Navy, is rated at 20 kva at 85-90% efficiency. However, the design concept allows for development and production of similar units from 3 to 120 kva.

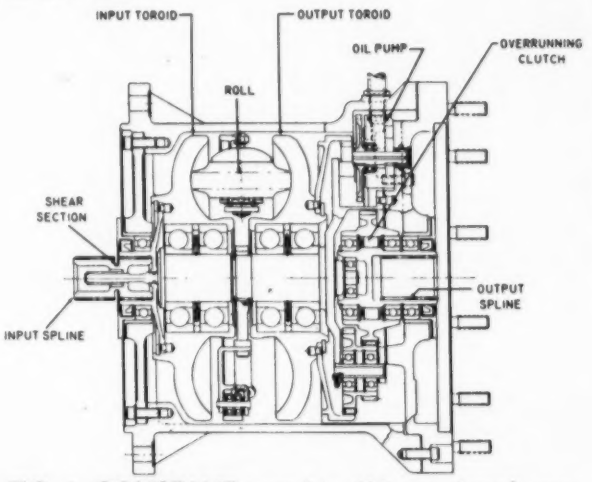

FIG. 1. CONSTANT speed to 400 cps aircraft generator from widely-varying engine speeds is accomplished by new versatile speed drive.

Operation is simple. The engine accessory drive rotates the input toroid (See outline diagram), which, through friction, turns the rollers and they in turn drive the output toroid. The angle of the rolls is changed to create the necessary speed differential to maintain constant output speed. A control system senses deviations from fixed frequency signal and an electrical actuator adjusts the speed ratio in the drive.

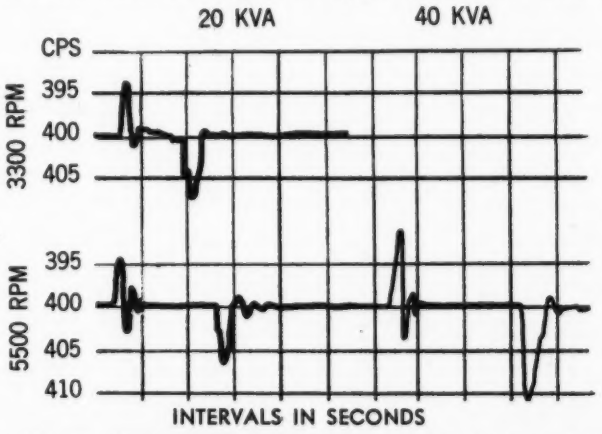

FIG. 2. GENERATOR frequency quickly returns to normal after shock loads of 20 kva.

Output speeds of 6000, 8000 or 1200 rpm can be provided by the output planetary gearing. Specifications include: Input speed for 20 kva unit, 2300-9025 rpm; output power, 30 hp continuous; 45 hp for 5 minutes, and 60 hp for 5 seconds. Frequency characteristics: Steady state, ±¼% output speed control; for shock load of 20 kva, max deviation ±4%, returning to ±½% in 1 sec. (See graph).—(*From new 4-page brochure, Lycoming Div., Avco Mfg. Corp., 550 S. Main St., Stratford, Conn.*)

For this literature circle **105** on inquiry card.

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For more information on "Pig-Tailor" circle **14.**
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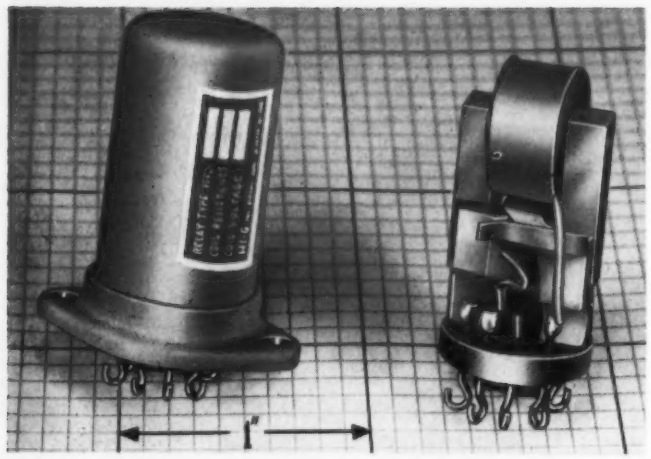

FIG. 1. ROTARY BALANCED ARMATURE design combined with permanent magnet stabilization of unoperated condition withstands heavy vibration in both states. In new method (Pat. Applied For), permanent magnet replaces spring, holds armature in unoperated condition.

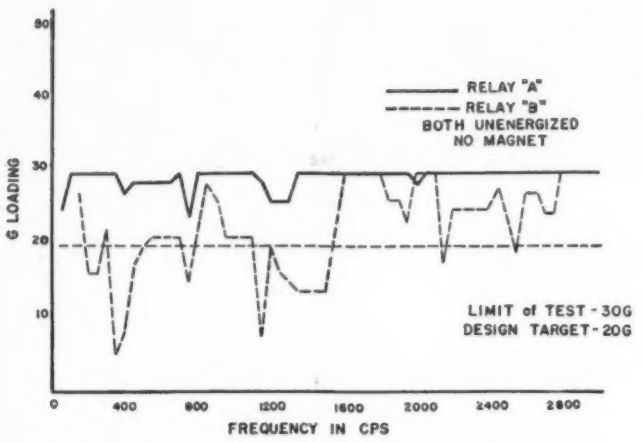

FIG. 2. TWO BALANCED ARMATURE type relays of conventional design are vibrated in the unenergized condition. Properly adjusted relay "A" meets design target; improperly adjusted relay "B" falls below specification requirements.

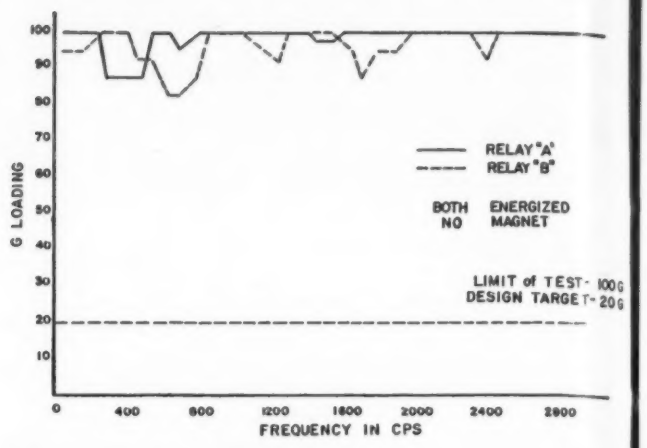

FIG. 3. SAME TWO RELAYS are vibration tested in the energized state. Stability of both relays is high, with similar characteristics.

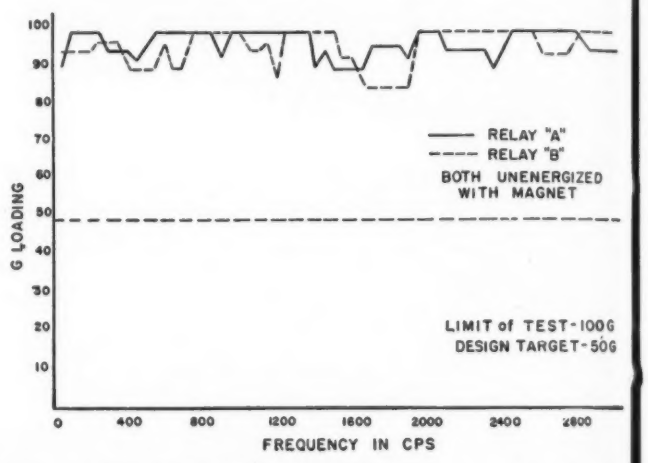

FIG. 4. "HOLD OPEN" MAGNETS are added to the same two relays in unenergized condition. Note that both relays are now "superior" relays.

RELAY DESIGN FOR HIGH VIBRATION

John A. Pfingsten, Hi-G Incorporated

RAPID DEVELOPMENTS in aircraft and missile systems during the past few years have imposed increasingly difficult environmental conditions which must be met by the components used. Reliability depends upon the component operating at its rated characteristic under extremes of temperature and vibration, and for long periods of time. Relays of various designs have been on the market for many years, but only recently have they been able to approach the reliability of other components now available. Vibration has been a particular pitfall of the relay.

A rotary, balanced armature design (illustrated in the cutaway view in Fig. 1) provides improved characteristics for relays under vibration. The rotary system has inherent advantages, since under conditions of shock and vibration, very little momentum is built up in the moving parts of the system. With this type of construction it is normal to expect a relay to withstand 20 or 30 G out to 2,000 cps and with reasonable power input.

However, if it is desired that the power input be reduced while still retaining the resistance to vibration, or if higher values of G loading are needed, the rotary unit still has limitations in its basic form. Also, a unit which is not properly assembled and adjusted, or which does not have proper mechanical tolerances, will not come up to specifications under vibration.

As an example, assume that the relay is unenergized (the most critical position). The armature is under no constraint and is free to move easily. Without proper tolerances on its bearings, and with slight unbalance, there will be resonant points over the frequency spectrum. At these resonant spots, the armature tends to oscillate and sooner or later will move far enough to "bat" the normally closed contacts open, thus causing contact chatter. This condition is illustrated in Fig. 2 which shows vibration curves for two identical types of relay units. One of them (A) has proper tolerances and adjustments, the other (B) has not. This indicates how the poorer relay falls considerably below the design target of 20 G vibration. However, the basic design, if constructed properly, does meet the specification. These tests were run in the unenergized position. In Fig. 3, the same two relays were energized and subjected to the same tests. Here, they both easily pass the required vibration, and in fact, are very similar in their characteristics.

These problems can be solved to some degree by the use of a return spring on the armature to hold it in an open position when the relay is not energized. This solution brings new problems, however. Springs are subject to resonances and oscillation which sometimes reach violent proportions. In addition, the magnetic structure must overcome the pull of the spring throughout its complete travel, the energy required increasing as the armature moves closer to the poles. This, though it may seem insignificant, uses input power that might otherwise be utilized in heavier contact pressures.

A more effective method (used by Hi-G) is to leave out the return spring altogether, using all available energy for contact closure. Higher pressures then can be used on both the closed and open contact positions. Investigation has proven that the contact assembly of itself is very stable under vibration and shock, and that the remaining structure has been the limiting factor.

To improve stability in the unenergized condition without the use of springs, a permanent magnet is used to hold the armature in an open position. No resonances are involved in this method, and as the armature pulls away from the magnet when the coil is energized, the magnet has a decreasing effect, rather than increasing as with a spring. Full contact

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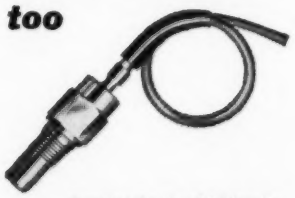

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pressures can thus be maintained in both the energized and unenergized positions. The magnet is placed so that the armature travels a distance approximately equal to the moving contact travel before hitting the moving contact. This means that during actual operation, the magnet has almost no effect whatsoever.

Fig. 4 shows performance curves on the same two relays as in Fig. 2, but with the magnets added. The G loading has been raised considerably, but the significant thing is that even the relay which showed poor results originally is now comparable to the good unit. Both units are now superior relays.

An additional advantage of using the magnet lies in providing relays to 20 or 30 G vibration, but with lower power requirements than could be used previously.

Using higher coil inputs and heavier contact pressures, relays can now be manufactured to withstand 50 G through 3,000 cps, and it is anticipated that special relays can withstand up to 150 G through 5,000 cps, and 300 G over certain bands of frequencies. Heavier mechanical mountings and internal construction will also be required in the latter types of application.

For more information on PM stabilized relays circle **250.**

Precision Gear Data AGMA Standard

A *tooth-to-tooth composite error* is the error which is shown as flicker on the indicator of a variable-center-distance fixture as the gear is rotated from tooth to tooth in intimate contact with the master. The flicker shows the effect of the following errors: Circular-pitch error, tooth-thickness variation, and profile error (See diagram).

TABLE 1 TOLERANCES FOR COMMERCIAL FINE-PITCH GEARS

Class	Total Composite Error, In.	Tooth-to-Tooth Composite Error, In.
Commercial 1	0.006	0.002
Commercial 2	0.004	0.0015
Commercial 3	0.002	0.001
Commercial 4	0.0015	0.0007

Note: Commercial gears should always be given first preference because they are cheaper to produce. Experience has shown that they are suitable for most fine-pitch applications.

TABLE 2 TOLERANCES FOR PRECISION FINE-PITCH GEARS

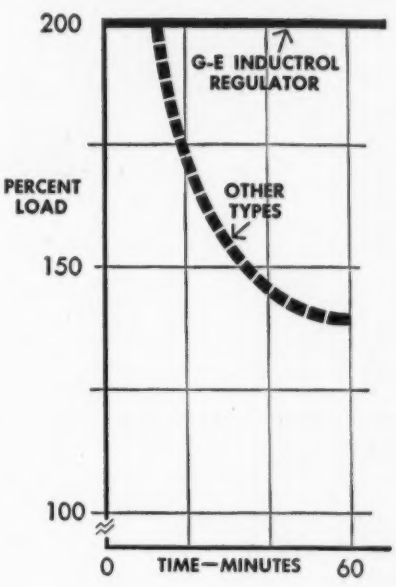
Class	Total Composite Error, In.	Tooth-to-Tooth Composite Error, In.
Precision 1	0.001	0.0004
Precision 2	0.0005	0.0003
Precision 3	0.00025*	0.0002

*This possibly would be the result of selection and segregation.

The *total composite error* is made up of runout, lateral runout and the tooth-to-tooth composite error. In other words, this error is the total center distance displacement read on the indicating device (See diagram). *From 92-page Catalog, "Fine Pitch Precision Stock Gears," U. S. Gear Corporation, 81 Bay State Road, Wakefield, Mass.*

For this literature circle **106** on inquiry card.

NO OVERLOAD PROBLEM



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For more information circle **16** on inquiry card.

PRESSURE IN ROCKET'S MOTOR IS ACCURATELY GAUGED

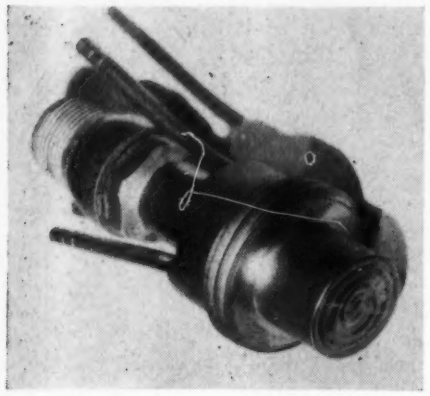

FIG. 1. DYNISCO PT49 TRANSDUCER with stainless steel diaphragm is designed for pressures to 2000 psi and for temperatures over 5000°F.

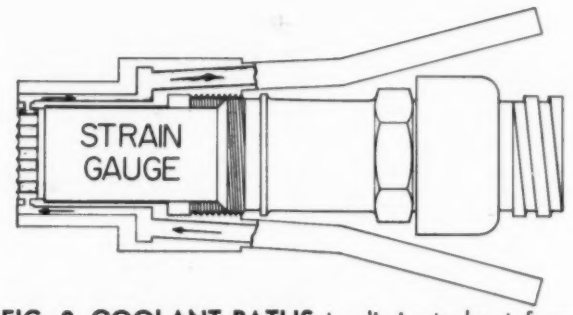

FIG. 2. COOLANT PATHS to dissipate heat from transducer face and mounting are in series to prevent formation of "hot spots."

PRESSURE GUAGES for rocket motor testing must operate with unchanged characteristics in flaming temperatures which would quickly melt a conventional pressure transducer. A new water-cooled pressure transducer, using the strain-gauge principle combined with a unique double-spiral cooling passage, is said to be successful in withstanding the most severe test conditions encountered in rocket motor tests. Used in a copper test motor at 600 psig chamber pressure it withstood gaseous ambient temperatures over 5000°F for an indefinite period.

Developed by the Dynamic Instrument Co., Inc., of 42 Carleton St., Cambridge 42, Mass., the new transducer, Dynisco PT49, is shown in Fig. 1. The coolant flow is constrained to a narrow passage which spirals toward the center, then outward to the periphery of the diaphragm (Fig. 2).

The flush-mounted diaphragm and high natural frequency (30,000 cps), make the PT49 ideal for studying phenomena involving high frequency transients. Its ½% accuracy and high overload protection are also of interest in many other applications in the field of pressure measurement. Other essential characteristics of the PT49 transducer include:

Physical Dimensions .....1" dia x 2⅞" long
Weight .....100 gm.
Pressure range ..... 500 psi 1000 psi 2000 psi
Overload Protection ....2000 psi 3000 psi 4000 psi
Electrical configuration .....2 active-arm strain gage with 800 ohms resistance.
Excitation voltage .....30 v ac or dc
Full scale output .....1.5 mv/v (approx.)
Zero-pressure output .....±10% of full scale
Deviation due to nonlinearity .....±½% full scale
Deviation due to hysteresis .....±½% full scale
Zero-pressure output change from exposure to acetylene flame .....1% max.
Zero-pressure output change from 500°F rise in mounting base temperature .....1% max.
Cooling water pressure .....Recommend 35 psi inlet, 5psi outlet pressure at 2 lb/min flow rate.
Heat transfer rate across diaphragm .....approx. 8 BTU/sq-in/sec (Coolant temp. rise 110°F at 2 lb/min flow).

For more information circle **107** on inquiry card.

Instrument Universality Aided by "Any-Frequency" Fan

Dual-frequency motor driven fans and blowers are used principally in the cooling of instruments and electronic test gear designed for use at military and non-military facilities for missiles and aircraft. Laboratories and hangars normally have 115 v ac, 60 cps power; while aircraft, missiles, and mobile line-power supplies are usually 115 v, 400 cps. Line frequencies higher than 400 cps are found on certain jet and reciprocating-engine aircraft. Frequencies lower than 60 cps are used abroad and for rare periods of short duration at US Air stations where the engines are powered by diesel engines.

Most instrument and test equipment manufacturers would like to furnish products which may be plugged into standard ac receptacles found at military installations. without additional switching operations required by varying frequencies. A major problem in achieving this universality has been the supply of power to motor-driven components in the test equipment, particularly the cooling fan.

With the above application in mind, the *Rotron Manufacturing Co., Woodstock, N. Y.*, has developed a two-pole ac fan (Fig. 1) which does not care what frequency it sees in normal practice and which requires no switching when frequencies change. When used in airborne equipment which operates at varying altitudes, these fans also exhibit *Altivar* characteristics, in which the shaft speed automatically increases with altitude to maintain constant cooling efficiency. The Rotron dual-frequency fan uses no commutators, sliprings, or barometric switches; requires no rectification, and generates no radio-frequency interference or brush-commutator maintenance problems.

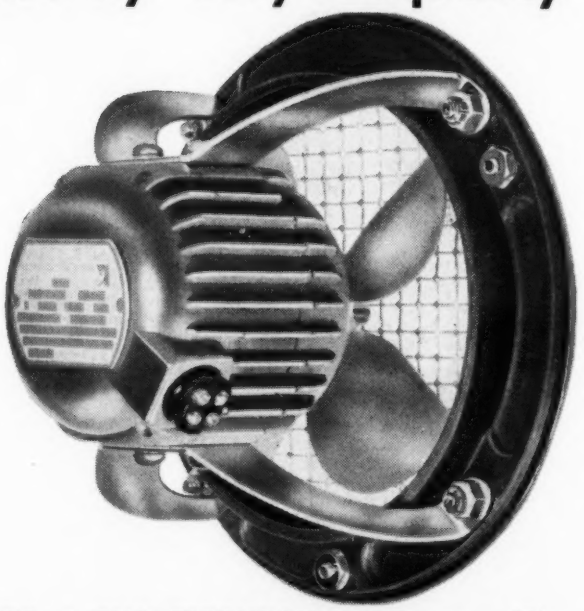

FIG. 1. DUAL-FREQUENCY FANS ignore differences in line frequency to provide cooling in test equipment used in military service locations. Line frequencies may vary from 45 to 600 cps, without switching.

Performance curves for a 4" Model DFE fan (Fig. 2), show that it delivers 82 cfm at 60 cps to 102 cfm at 400 cps. No mysterious principles of motor design, but careful matching of stator windings with rotor materials and new designs, are credited by the manufacturer for the ability of the fan to perform over so wide a range of frequencies without switching. Low power inputs of 20 and 33 watts, at 60 and 400 cps respectively, ensure cool fan and equipment operation.

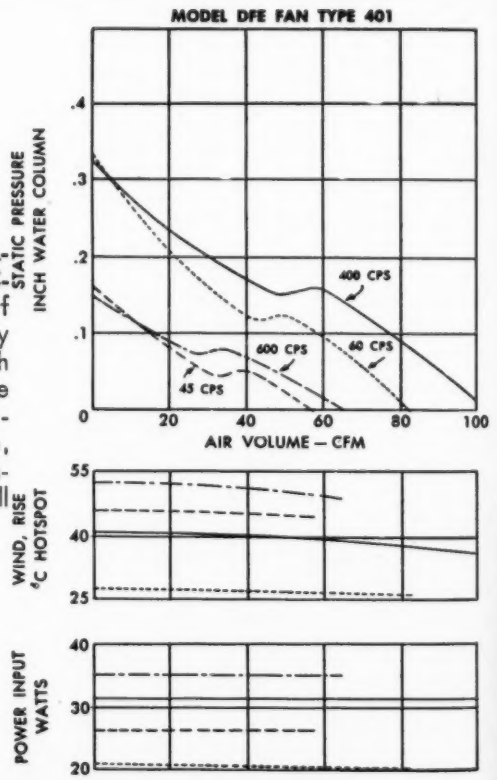

FIG. 2. VERSATILE CHARACTERISTICS of dual frequency fan show high performance over wide frequency range, low power consumption in all applications.

For more information circle **108** on inquiry card.

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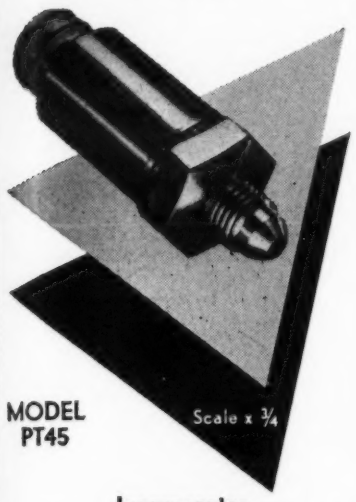
PICKUP



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For more information circle **17** on inquiry card.

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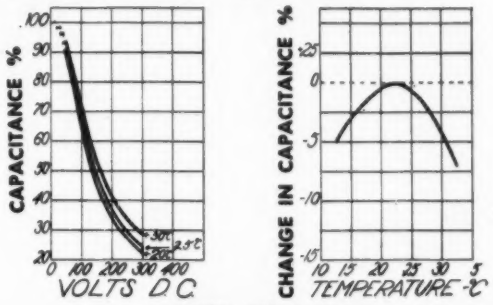


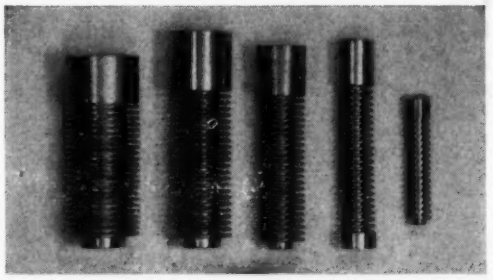
TYPES VSR & LVSR

Inasmuch as voltage-sensitive ceramic capacitors are also temperature-sensitive, Mucon can furnish Types VSR and LVSR which have maximum voltage-sensitivity at approx room temperature (25°C) or Types VSE and LVSE which have maximum voltage-sensitivity when operated at approximately 70°C.—(*From 1-page Bulletin No. H-2, "Voltage Sensitive Ceramic Capacitors."—Mucon Corp., 9 St. Francis St., Newark 5, N. J.*)

For this literature circle **109** on inquiry card.

Miniature Instrument Bellows Helps Shrink Existing Designs

New metal bellows made to customer's specifications are now available from ⅛" to 1" O.D. in any wall thinness down to 0.0008". Made of a nickel alloy of high tensile strength and low hysteresis, they resist corrosion and oxidation at temperatures to 500°F.

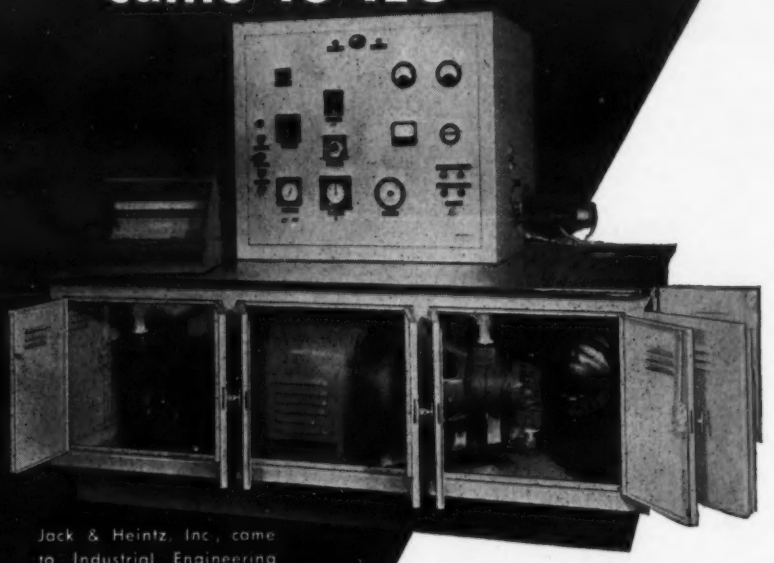


Bellows operated thermostats, bellows packed valves, hermetic rotary seals, pressure transducers, and other bellows operated devices can utilize the low spring rates, long strokes and low hysteresis provided by the new thin-wall elements. For the instrument designer they are said to offer an opportunity to miniaturize existing designs with little or no loss of sensitivity and performance. For designers now using rubber or plastic bellows, they provide in metal the low spring rate of plastic units. A free sample for inspection will be mailed by the maker, Servometer Corp., P. O. Box 42, Clifton, N. J., in response to inquiries.

For more information and sample circle **110** on inquiry card.

Need test stands?

JACK & HEINTZ, INC. came to IEC



Jack & Heintz, Inc., came to Industrial Engineering Corporation for the design and construction of this electrical actuator test stand for testing Boeing B-52 component parts.

IF your problem is functional test equipment or control panels, Industrial Engineering Corporation can supply the answer. Whether your needs call for the use of hydraulic, pneumatic, electric or electronic principles—singly or in any combination — IEC has the imagination, the ability, the facilities to handle the job *right,* from original design to actual installation.

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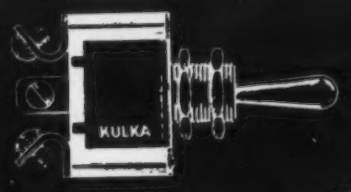

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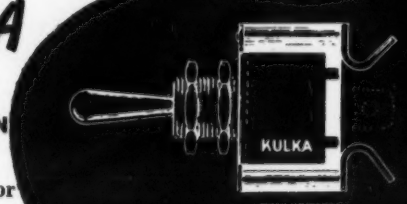

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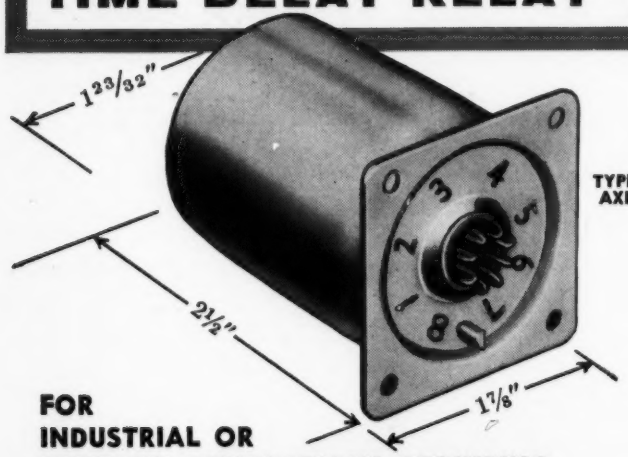

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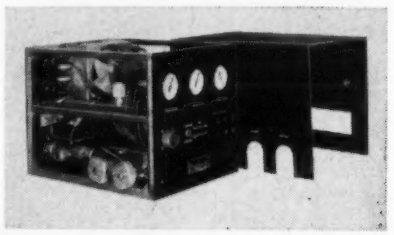
MA New Products

I-R CELL COOLING SYSTEM

New cooling system, designated Model RS-25, Type 100, for detecting cell of infrared search systems fea-

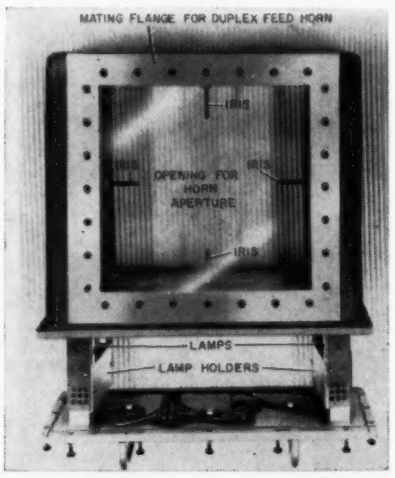


tures two-stage piston type compressor to achieve cell temperatures down to −70°C by direct expansion. For airborne or ground use, it weighs 32 lbs, measures 10″ x 14″ x 10″ high, uses 200 v 400 cps 3-phase power, and operates up to ambients of 85°F and altitudes of 5,000 ft.—*Eastern Industries, Inc.*, 100 *Skiff St., Hamden, Conn.*

For more information circle **111** on inquiry card.

DEW-LINE ANTENNA ANTI-ICER

Two quartz infrared-lamps housed in cast-aluminum horn-extension assembly supply radiant energy which falls directly on antenna aperture window. Radiant energy absorbed by

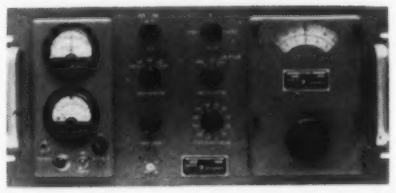


the window raises its temperature; that passing through window heats the air around the outer surfaces of the window, also helping to prevent ice formation on Arctic radar and tropospheric-scatter communications antennas.—*Gabriel Electronics Div., Gabriel Co., Needham Heights, Mass.*

For more information circle **112** on inquiry card.

COUNTERMEASURES RECEIVER

New type 13A1 countermeasures and intercept receiver covers range from 55 to 260 mc, includes a preci-

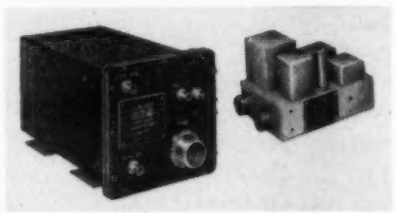


sion-gear drive assembly for motor scan use, replaceable 416B and inductuner tuning unit for simplified maintenance, plug-in tuning head, and an effective pulse AGC system.—*General Electronic Labs., Inc.*, 195 *Massachusetts Ave., Cambridge* 39, *Mass.*

For more information circle **113** on inquiry card.

MISSILE BEACON

New high-sensitivity S-band beacon for guided missile and drone-control applications features triggering sen-



sitivity of 65 dbm, 50 db (min) image rejection in receiver, with 100 watts transmitter power in the 2850- 2950 mc range. Transmitter-receiver weight is 8 lbs, 115 v 400 cps power supply weighs 5.5 lbs. A 28 v dc supply is also available.—*Telerad Mfg. Corp.*, 1440 *Broadway New York* 18, *N. Y.*

For more information circle **114** on inquiry card.

X-BAND ISOLATOR

New microwave ferrite isolator, Model IXLIO, provides 22 db isolation over the 9.0-10.0 kmc range. Maximum insertion loss is 0.4 db and max VSWR is 1.25 over the range. Weighing 6 oz, its length is 1.04″ with input and output flanges rotated by 45°. Other models with flanges in-line or rotated 90° are available.—*Raytheon Mfg. Co., Special Microwave Device Group, Waltham* 54, *Mass.*

For more information circle **115** on inquiry card.

DIELECTRIC MODEL RANGE TOWER

New styrofoam Series 401 model range tower with head drive linkage of nylon gears, glass bearings and glass-reinforced epoxy tubes, allows reflectivity or radiation pattern measurements to be made under simulated free space conditions.—*Scientific-Atlanta, Inc.*, 2162 *Piedmont Rd. N. E., Atlanta* 9, *Ga.*

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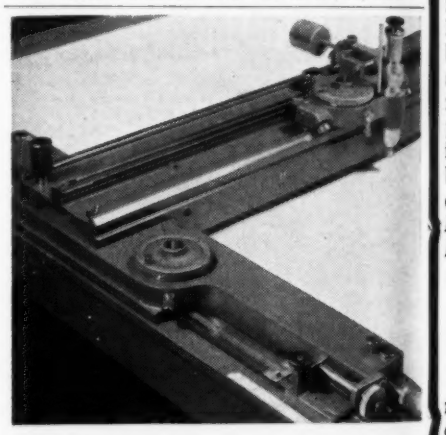

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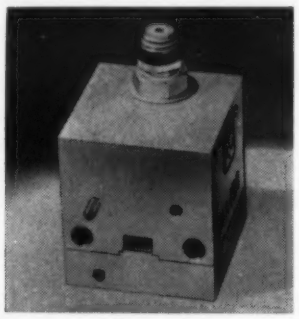
For more information circle **22** on inquiry card.

MICROWAVE DIODE

New broadband high-sensitivity microwave diode, Type MA-428, designed for use as a pair in rat race power-divider (MA-606) balanced mixer assembly in conjunction with a low-noise IF strip is said to achieve



a system noise figure between 15 and 18 db, in the 50 to 75 kmc range. Also can be used as a high sensitivity detector in low-level video receiver applications in the 50-75 kmc band. MA-428 (approx. ¾" x ¾" 1.1" requires no mount, being bolted directly to RG-98/U waveguide flanges. Microdot connector on top face of diode provides video or IF output.—*Microwave Associates, Inc., Burlington, Mass.*

For more information circle **117** on inquiry card.

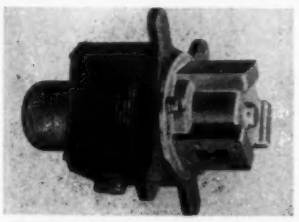
SPECTRUM ANALYZER

New Model SA-84 analyzer covers the range from 10 mc to 40,880 mc in single unit to display pulse-modulation components, attenuation and band-width characteristics, radiation and interference signals, etc. Simplified band selector automatically displays expanded slide-rule dial of band in use to prevent operator error; built-in attenuators and stable local oscillators are featured.—*Polarad Electronics Corp.*, 43-20 34*th St., Long Island City* 1, *N. Y.*

For more information circle **118** on inquiry card.

RIDGED WAVEGUIDE SWITCH

Double-ridged waveguide switch, model H14A2AA, has broad frequency characteristics to match those of DR-



19 or equivilant waveguide. Designed for airborne use, it also has potential for ground application. Frequency range is 4.76 to 11.0 kmc with maximum insertion loss of 0.5 db, VSWR of 1.15:1 or better, and crosstalk in excess of 40 db down. Life of the unit is over 100,000 actuations.—*Thompson Products, Inc.*, 2196 *Clarkwood Rd., Cleveland* 3, *Ohio*

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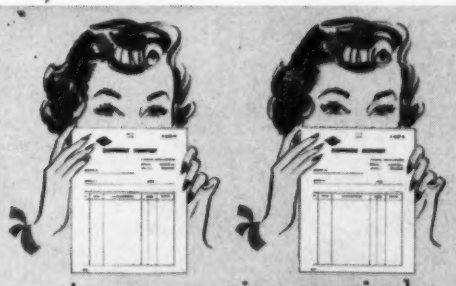

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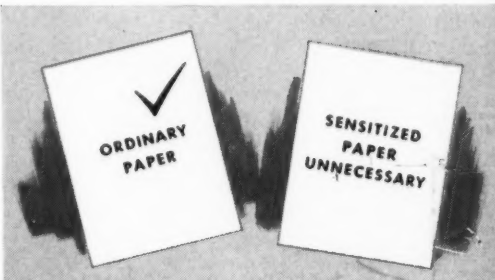

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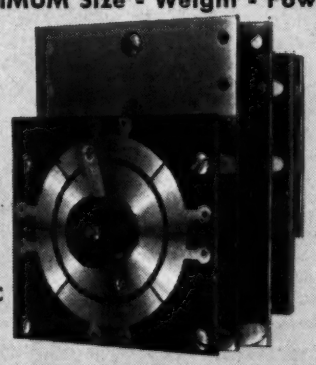
MINIMUM Size - Weight - Power Drain



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Segments per deck—2-8 for stock units.
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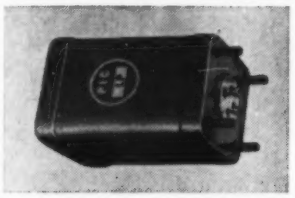
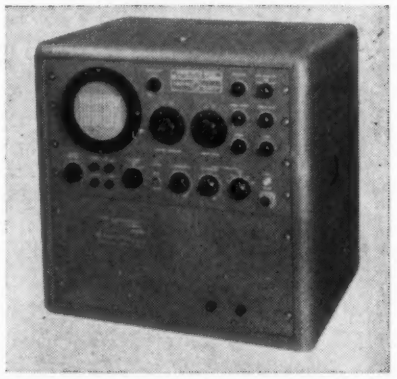
Custom-designed Chebishev type high-pass and low-pass electrical wave filters with cutoff frequencies up to 100 kc feature high attenuation, low insertion loss and excellent stability over a wide temperature range. Available in hermetically sealed metal (as shown), or in epoxy molded construction to conform to design requirements; meet applicable Mil-Specs.—*Polyphase Inst. Co., East 4th St., Bridgeport, Montgomery Co., Pa.*



For more information circle **120** on inquiry card.

BROAD RANGE ANALYZER

New multipurpose spectrum analyzer, designated SPA-3, covers overall frequency range from 200 cps to 15 mc is suitable for video, pulse and noise studies, also ultrasonic and RF waveform analyses. Spectrum segments up to 3 mc wide, centered anywhere from 0 to 13.5 mc, can be expanded for fine definition. Instrument has 3 amplitude scales—linear, 40 db log and power; 100 db calibrated attenuators; 20 μv full scale sensitivity and is flat to ± 1 db. *Panoramic Radio Products, Inc., 514 S. Fulton Ave., Mount Vernon, N. Y.*



For more information circle **121** on inquiry card.

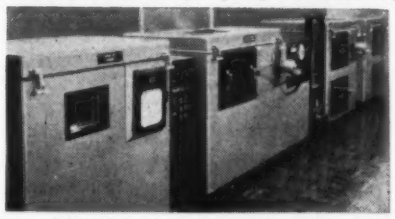
MONITOR GUARDS CIRCUIT

New Model 4.010 electric monitoring system which detects variations in conditions of voltage, frequency and phase in any power source operates switches or alarms in response to abnormalities. Capacitive time delays prevent tripping of protective devices by harmless transients; specifications include: Voltages from 6 to 440, frequencies from 25 to 1600 cps; 0.2 sec response time; time delay from 0 to 15 sec; and 5 am.-600 watt relaying capacity.—*Electric Regulator Corp., Pearl St., Norwalk, Conn.*

For more information circle **122** on inquiry card.

PACKAGED LABORATORIES

PET (Production Environmental Testing) requirements specified in new MIL standards and specifications are automatically programmed by new Mantec "packaged" laboratory in combinations and sequences of environments desired. Specimens on plug-in panels can be moved from one altitude-temperature chamber to the next, also the altitude plenum of the altitude-temperature chamber can be operated separately or in other temperature chambers.—*Wyle Associates, 128 Maryland St., El Segundo, Calif.*



For more information circle **123** on inquiry card.

AUTOMATIC RELAY TESTER

Ten relays can be simultaneously tested through a cycle determining for each relay the normal operate time, saturate release time, or release time after predetermined heating. Test proceeds automatically after starting, reading time interims for each relay in seconds and tenths on digital timing clocks. Energizing voltages from 2.5 v to 230 v are available, also relay-holding test panel which can be placed in environmental testing chamber.—*G-V Controls, Inc., 28 Hollywood Plaza, East Orange, N. J.*

For more information circle **124** on inquiry card.

VOLTMETER INVERTER

New instrument accessory permits accurate low-level dc voltage measurements using a standard ac-only VTVM. Designated the Type D-100 voltmeter inverter, a high-quality instrument chopper with a calibrating signal source and output level adjustment are provided so that the ac VTVM can read dc voltage directly. *Microdyne, 300 W. Washington St., Chicago 6, Ill.*

For more information circle **125** on inquiry card.

CONVENIENT "Q" METER

Quick measurements of circuit magnification, inductance, capacitance and power factor at frequencies from 100 kc to 100 mc are made by new ac-operated instrument. "Q" meter generates an internal signal adjusted to a measured pre-set amplitude. Coil under test is then resonated in series with internal low-loss, variable capacitor. Voltage across capacitor, which indicates the "Q", is read directly from sensitive voltmeter calibrated in "Q" units.—*North Hills Electric Co., Inc., 402 Sagamore Ave., Mineola, L. I., N. Y.*

For more information circle **126** on inquiry card.

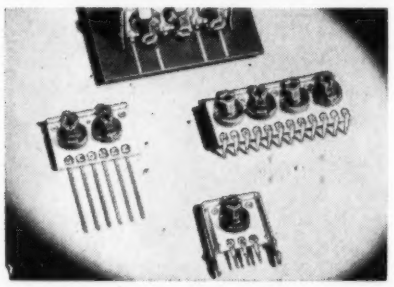
100-CHANNEL EVENT RECORDER

New compact instrument records 100 channels of operational information simultaneously on a moving, dry, electro-sensitive chart 12" wide and 500' long. Rapid response permits up to 500 signal changes/sec, also on-site or remote selection of eight standard chart speeds to an accuracy of ¼% at constant line frequency. Mounts in any 19" standard rack, table console or on mobile cart (enclosures available). Adapts to MIL-E-4158A and other Mil-specs.—*Brush Instruments, Div., Clevite Corp.,* 3405 *Perkins Ave., Cleveland* 14, *Ohio*

For more information circle **127** on inquiry card.

MINIATURE VARIABLE RESISTOR

New ¼ watt Model 5 multiple miniature variable resistor, available in 1000 ohm to 5 megohm sizes, can



be supplied in up to 4 units on a single steatite base. Fixed resistors and capacitors also can be incorporated to make a complete sub-circuit.—*Centralab, Div. of Globe-Union Inc.,* 900 *E. Keefe Ave., Milwaukee, Wisc.*

For more information circle **128** on inquiry card.

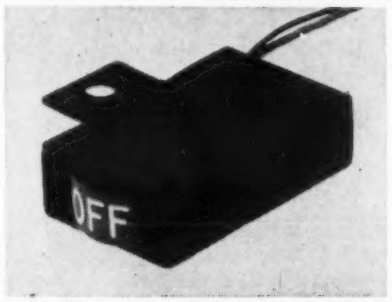
LONG SHELF LIFE FOR SEMICONDUCTOR ALLOYS

New packaging technique seals oxidizable metals and alloys, such as indium, lead antimony, indium gallium, etc., in containers with an Argon atmosphere. Method permits manufacturers of semiconductors to realize quantity savings by inventory of materials formerly purchased frequently and only in small lots.—*Accurate Specialties Co.,* 37-11 *57th St., Woodside* 77, *N. Y.*

For more information circle **129** on inquiry card.

MINIATURE INDICATOR

New type 109 electromagnetic 2-position indicator draws only 2 watts

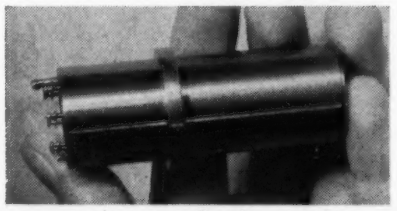


up to 28 v dc, weighs only 9 grams. Its rectangular face measures $\frac{9}{16}$" x $\frac{3}{16}$", can be mounted and operated in any position. Meets MIL-E-5272A. —*Allard Instrument Corp.,* 146 *E. Second St., Mineola, N. Y.*

For more information circle **130** on inquiry card.

SUBMINIATURE RATE GYRO

Type RGB floated rate gyro provides constant damping ratio (± 0.1) over the range −30° to 100°C, by means of a new fluid temperature-

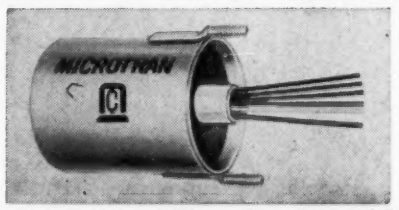


compensating mechanism using no linkages. Pickoff output is 5.6 v rms with standard excitation; resolution is 0.01% of full scale. Technical bulletin No. 723 with detailed specifications is available on request.—*Sanders Associates, Inc., Nashua, N. H.*

For more information circle **131** on inquiry card.

CHOPPER TRANSFORMER

New low-level chopper input transformers transfer 30 to 500 cps transducer or thermocouple signals to



instrument amplifiers. Low hum pickup, minimum mechanical vibration noise signal, accurate centertaps and external electrostatic shield to improve operation on signal levels from 0.5 μv to 0.5 v, are featured.—*Microtran, Co., Inc.,* 145 *E. Mineola Ave., Valley Stream, N. Y.*

For more information circle **132** on inquiry card.

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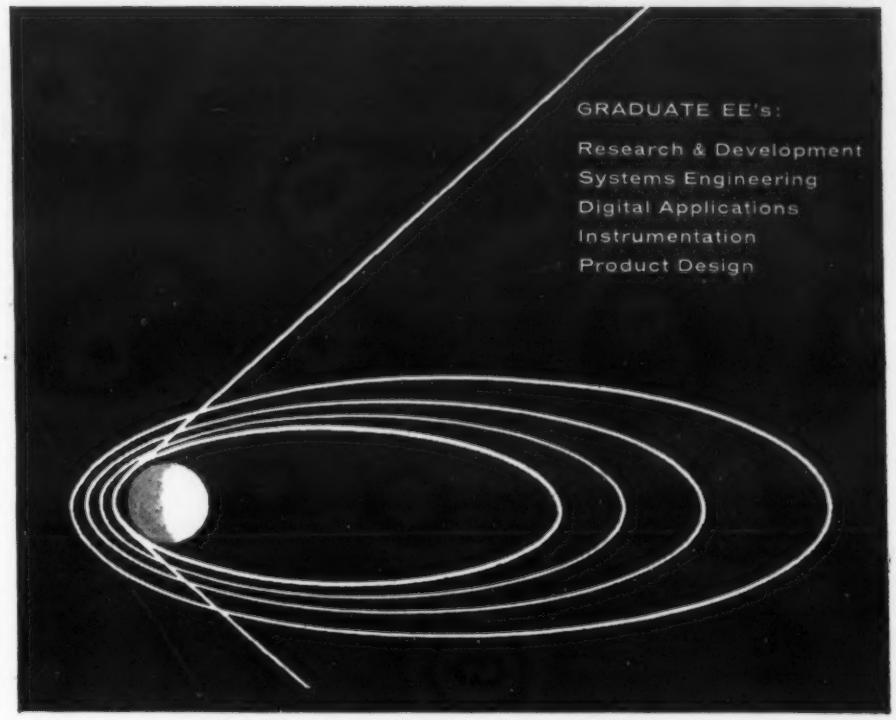

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The great technical challenges of guidance for space exploration lie in the unprecedented accuracies, reliabilities and long operative life-spans that must be engineered into the guidance systems.

ENGINEERS and SCIENTISTS at G.E.'s Missile Guidance Section—with their broad experience in creating highly reliable ICBM systems are well prepared to deal creatively and effectively with space problems.

FOR WORK IN FRONTIER AREAS, look into the positions now open with the Section, on a number of stimulating, advanced projects.

Significant experience in 1 or more of these areas is desired:

Radar
Communications
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Microwaves
RF Circuitry
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Test Operations
Engineering Analysis

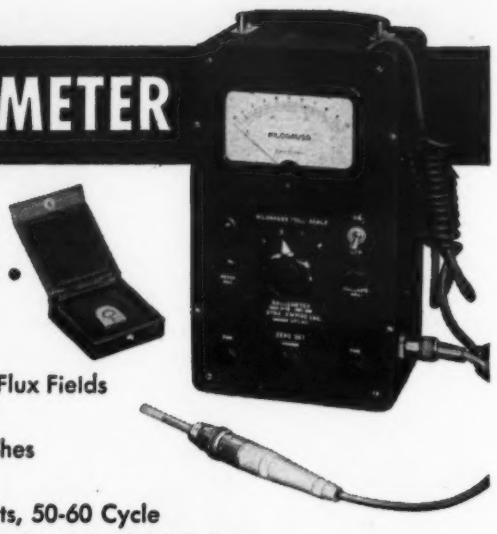
Forward your resume in strict confidence to
Mr. E. A. Smith, Dept. 7K

MISSILE GUIDANCE SECTION
GENERAL ELECTRIC
Court Street, Syracuse, N. Y.

For more information circle **27** on inquiry card.

D-79 GAUSSMETER

Means More In MAGNETICS..



HERE'S WHY:

- Reads 10 to 30,000 Gauss Flux Fields
- Probe is only .025" thick
- Active area .01 square inches
- Net Weight 10-1/2 lbs.
- Power Supply 105-125 Volts, 50-60 Cycle
- Overall size 13" high, 10-1/2" wide, 6-3/4" deep

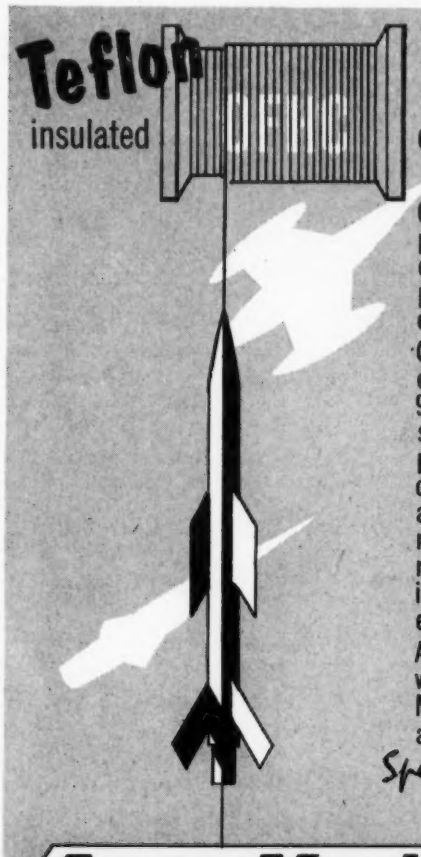
Precision built to give accurate flux density measurement and determine "flow" direction. The unit also locates and measures "stray fields," plots variations in strength, and is ideal for checking production lots against a standard. Simple to operate, the D-79 gives no ballistic reading . . . doesn't jerk or pull. Comes in protective carrying case.

Write for literature—Dept. MA-858

DYNA-EMPIRE, INC.
1075 STEWART AVE.
GARDEN CITY, N. Y.
Phone
Pioneer 1-2700

For more information circle **28** on inquiry card.

Teflon insulated OFHC copper wire and cable



Oxygen-free, high-conductivity copper, processed into Aero-Marine teflon-insulated wire and cable, provides almost complete protection against oxydation at high operating temperatures.

OFHC copper is a superior grade; the pure copper content being in the order of 99.99%. The absence of extraneous inclusions considerably improves ductility, provides higher electrical and thermal conductivity, increases impact strength and creep resistance and produces immunity to deterioration when heated. These remarkably improved physical characteristics are particularly significant where end use will be in the area of high heat.

Aero-Marine teflon-insulated OFHC copper wire and cable exceeds requirements of MIL-W-16878 and is immediately available at standard prices.

Specify Aero-Marine teflon-insulated OFHC copper wire and cable. Write for bulletin.

Aero-Marine
DEVELOPMENT CORPORATION, CHATHAM, N. J.

Teflon: DuPont trademark
OFHC: American Metals Corp. trademark

For more information circle **29** on inquiry card.

New Products—CONT.

NON-CORROSIVE PRESSURE SWITCH

New stainless steel high-pressure switch for aircraft and missile use can be used to control flow of corrosive liquids, such as red fuming nitric acid. Withstands pressures of

6800 psi without leakage while subjected to ambients from −65°F and meeting vibration specs of MIL-E-5272A. Also available for ambients to 275°F. SPDT switch is rated at 28 v dc, 5 amp resistive.—*Aircraft Controls Co., Div., Gorn Electric Co., Inc.*, 845 *Main St., Stamford, Conn.*

For more information circle **133** on inquiry card.

NEW LINEAR ACCELEROMETER ELIMINATES FRICTION

New ac linear accelerometer for aircraft and missiles, designated Type LA-600, consists of non-pendulous seismic mass supported on a frictionless spring suspension with an ac variable reluctance pickoff. Inherently insensitive to cross-coupling accelerations, the unit also features near-constant magnetic damping ratio from −65° to 250°F. Other specifications: Full scale range, ± 0.5 to ± 40 G; full scale output, up to 10 v, 400 cps; threshold, 0.0001 G; vibration, 10 G, 0-2000 cps; shock, to 60 G.—*Boston Div., Minneapolis-Honeywell*, 40 *Life St., Boston* 35, *Mass.*

For more information circle **134** on inquiry card.

"PLUG-IN" SERVO REPEATER

New miniature servo repeater system comprises a servo amplifier, servo motor, potentiometer, input step-down transformer and gear train all in modular unit approx 2"

dia by 4" long, weighing only 13 oz. Designated the model W 1902, unit positions its output shaft proportional to a 400 cps signal voltage.—*Waldorf Inst. Co., Electronics Div., Huntington Sta., L. I., N. Y.*

For more information circle **135** on inquiry card.

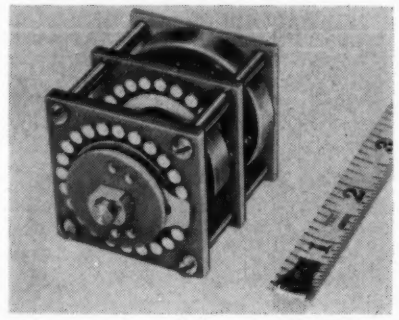
DIODE TEST SET

New automatic diode test set Model 5002AB automatically compares dc forward and reverse characteristics of semi-conductors diodes against preset limits and presents results in go-no-go form. Forward power; 0.1 to 50 v; reverse power, 0.1 to 500 v. Regulated voltage supply. Automatic readout, etc. are available in other models.—*Measurements Research Co.*, 3801 *Castor Ave., Philadelphia* 24, *Pa.*

For more information circle **136** on inquiry card.

MULTIPOSITION SWITCH ROTOR

A special rotor, for all Daven Single Pole Switches, will break up to 5 amp resistive at 115 v. The



1¾" special switch provides 32 positions, 2¼" size provides 48 positions, 3" size gives 60 positions. All sizes operate with make-before-break (shorting) contacts.—*The Daven Co., Livingston, N. J.*

For more information circle **137** on inquiry card.

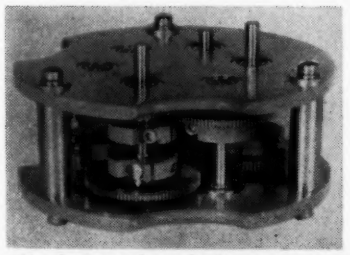
SUB-MIN SPDT CHOPPERS

New 7- and 4-pin SPDT James patented center-pivot-design choppers with both MBB and BBM contacts are available in frequency ranges from 0-120 cps and 350-475 cps. Subminiature size, low residual noise and minimum thermal drift are features.—*James Vibrapower Co.*, 4050 *N. Rockwell, Chicago* 18, *Ill.*

For more information circle **138** on inquiry card.

PRECISION GEAR BOX

New adaptable gear box provides choice of gearing configurations from 1:1 to 3125:1. Stocked shafts, gears, antibacklash gears and slip clutches

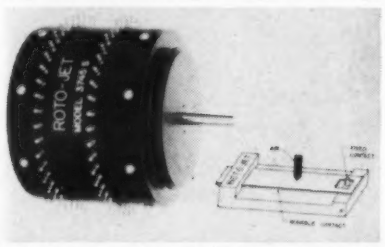


permit choice of and changes in gear configurations; eliminating time, cost and engineering effort to develop special gear trains; meets requirements of MIL-E-5400.—*Precision Mechanisms Corp.*, 577 *Newbridge Ave., East Meadow, N. Y.*

For more information circle **139** on inquiry card.

AIR-JET ACTUATED SWITCH

New Roto-Jet high speed commutating switch has only one rotating part, an accurately shaped air jet.



Stationary contact points are actuated positively by jet, contact "noise" and wear are greatly reduced. Model 3745 comprises 45 isolated SPST normally-open contacts which can be combined as required. Data bulletin available.—*Norman Hardy Associates, P. O. Box 97, Wyncote, Penna.*

For more information circle **140** on inquiry card.

AIRBORNE TELEMETERING COMMUTATOR

New solid-state airborne commutator weighing less than 30 oz commutates 30 channels at rates up to 2500 samples/sec or any IRIG commutation rate. Several commutators may be cascaded for greater channel capacity. The unit operates at 40 G acceleration and in ambients from 0° to 85°C.—*Wiancko Engineering Co., 255 N. Halstead Ave., Pasadena, Calif.*

For more information circle **141** on inquiry card.

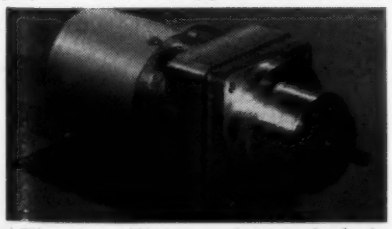
FLOATED RATE GYROS

New floated viscous damped rate gyros, subminiature RC-10S20 and miniature R-99S86, using ac spin motors and microsyn pickoffs, feature low threshold, minimum hysteresis, high natural frequency and excellent linearity; are ruggedized for tough environmental conditions in missiles and high-performance aircraft.—*Daystrom Pacific, 9320 Lincoln Blvd., Los Angeles 45, Calif.*

For more information circle **142** on inquiry card.

CONSTANT SPEED POWER DRIVE

New constant speed drive for computer and control system applications provides an output of 16 oz-in of torque at a constant speed of 1000 rpm, ± 0.1%. A typical unit, shown



in Fig. 1, utilizes an internal timing motor requiring only 3 watts power at 28 v dc, ±20%. Input unregulated rotational power is delivered through any necessary reduction gearing to the constant speed unit at an input speed of 1100 rpm +15%. Typical applications for the new unit include differential and integrating analog computers and sequence controllers for missile guidance and control systems.—*M. ten Bosch, Inc., Pleasantville, N. Y.*

For more information circle **143** on inquiry card.

SERVO CONSTRUCTION KIT

New kit form of servo construction system, successfully used in the Signal Corp's Moon Computer, includes AGMA precision Class II gear, ABEC class 7 bearings and equally-spaced jig-bored holes to ensure operational exactness. R & D engineering time is saved, changes are readily made, and duplicates for operational use can be constructed without need for tailor-made adjustments.—*Gap Instrument Corp., 33 So. Grove St., Freeport, L. I., N. Y.*

For more information circle **144** on inquiry card.

CONCENTRIC SHAFT SPEED REDUCER

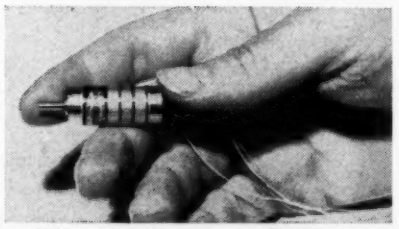
New single-ended speed reducer receives power through inner, high speed shaft; delivers output through concentric sleeve. New format per-

mits mounting of driving sources, potentiometers, or other actuated devices on the same baseplate, saving weight and space, and achieving better reliability through greater mounting rigidity. Detailed information on gear ratios, reducer sizes and modifications is available on request.—*Bowmar Inst. Corp., 8028 Bluffton Rd., Fort Wayne, Ind.*

For more information circle **145** on inquiry card.

BUORD SIZE 5 SERVOMOTOR

New 400 cps servomotor weighing only 0.85 oz is designated Model 5S1-3, operates from 26 v fixed phase and 40 v CT control phase for transistorized

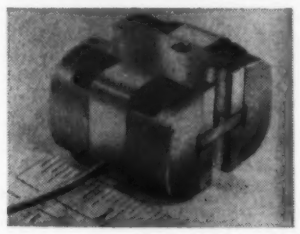


amplifier applications. Stall torque is 0.1 oz-in minimum; max power output, 0.3 watts at 6,000 rpm. Nominal no load speed is 11,000 rpm with 42,000 radians/sec² theoretical acceleration.—*Mechatrol Div., Servomechanisms, Inc., 1200 Prospect Ave., Westbury, L. I., N. Y.*

For more information circle **146** on inquiry card.

TORQUE MOTOR

New Model 102 high performance torque motor delivers a force of ± 5 lbs from midposition with a stroke of 0.007" in either direction. Moment

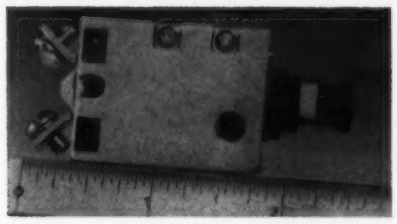


of inertia is 12.5 μin-lb-sec². Resonant frequency is 800 cps, can be furnished with coils for driving from tubes, magamps or transistors up to a maximum power of 2.75 watts. Meets military shock and vibration specifications.—*American Measurement & Control, Inc., 240 Calvary St., Waltham, Mass.*

For more information circle **147** on inquiry card.

MINIATURE AC-DC BREAKER

New fast-acting airborne circuit-breaker for protection of low-current circuits is small, simple and environmentally resistant. Used in 30 v dc



or 115 v 400 cps circuits of ½ to 3 amperes capacity, is readily reset when it trips, and serves as a manual switch. Also used for circuits in missile ground control equipment, testing equipment, and electronics equipment of all kinds.—*Mechanical Products, Inc., Jackson, Mich.*

For more information circle **148** on inquiry card.

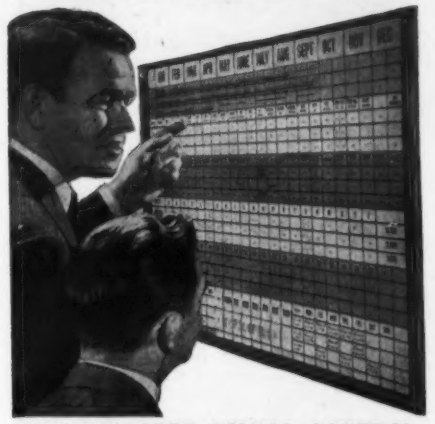
MAGNETIC TACHOMETER

New transistorized Tach-Pak converts signal frequency from a magnetic transducer to dc proportional

to frequency and rpm. The proximity pickup is not attached to any moving system component; system operates from 115 v, 50 to 400 cps, or from 12 v dc source. All units in new 5400 Series have a linearity of 0.25% in ranges from 0 to 60,000 rpm.—*Airpax Products Co., City of Plantation, Fort Lauderdale, Fla.*

For more information circle **149** on inquiry card.

How To Get Things Done Better And Faster



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For more information circle **30** on inquiry card.

NORTHAM

DIFFERENTIAL PRESSURE TRANSDUCER

Length: 2½" Weight: 12 oz.

A variable inductance instrument for measurement of differential pressures in ranges ± 200 to ± 5,000 psi and line pressures up to 5,000 psi. Designed for rocket and jet engine testing involving extreme mechanical disturbances, and for general laboratory measurement and industrial control applications.

MODEL DP-15 SPECIFICATIONS:

Pressure Ranges:..± 200 to ± 5,000 psid
Maximum Line Pressure:.....5,000 psi
Accuracy:.....± 1% full scale
Excitation Frequency: From 60 to 20,000 cps
Natural Frequency: From 2,000 cps to 10,000 cps depending on range
Acceleration Response: Less than 1%/1,000 g along most sensitive axis (range above 1,000 psi)
Less than 1%/1,000 g axial (all ranges)

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For more information circle **31** on inquiry card.

For your library . . .

Printed Circuitry

by Allan Lytel. A valuable working tool; includes alternative and recommended practice for each step in design and production of printed circuits; a buyer's guide to special components; and "how to" service data. Paperboard, illustrated, 192 pages, 1957. $2.00

Maintenance and Servicing of Electrical Instruments

by James Spencer. Useful to all instrument users, service men, switchboard attendants testing engineers, and others, this book covers construction, testing, applications, principles of operation and maintenance of all kinds of electrical indicating instruments. Clothbound, 274 illustrations, 280 pages, 1951 (third edition). $2.00

Process Control Analysis

by M. H. LaJoy and E. A. Baillif. An essential first step in analysis of closed-loop controlled processes via frequency response of the system. Clothbound, 72 pages, 1956. $2.00

The Computer Handbook

edited by M. H. Aronson. A clear introduction to the entire field of electronic computers and data processors. Presentations by computer manufacturers at the Second Computer Clinic. Paperbound, 72 pages, 1956. $2.00

Process Control

by A. J. Young. A "must" for all who have to do with the automatic control of industrial processes, this book combines for the first time the practical "how" and the theoretical "why". Paperbound, 134 pages, 1957 (second printing). $2.00

Operation and Care of Circular-Scale Instruments

by James Spencer. Includes "trouble" charts for d-c, and for a-c instruments; covers d-c instruments, a-c ammeters and voltmeters, wattmeters, frequency meters, power factor meters and synchroscopes. Clothbound, 90 pages, 1949. $1.50

Control Valves

by C. S. Beard. New "one-book" reference on control valves . . . covers flow characteristics; mechanical features; valve capacity; sizing; body types; positioners; actuators, including d-c, electrohydraulic and gas hydraulic actuators. Numerous tables and illustrations. Paperbound, 236 pages, 1957. $2.00

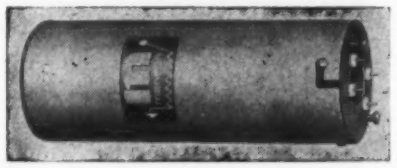
Instruments Publishing Co.

845 Ridge Avenue

Pittsburgh 12, Pa.

PRECISION CRYSTAL OVEN

New RD-134 crystal oven uses miniature mercury thermometer-type thermoswitch to provide drift-free reference for oven control to within



0.01°C at fixed ambient, and to within 0.1°C for ambients from 0° to 50°C. Heater element uses 1.8 watts at 24 v dc or 6.3 v ac. Rugged transistorized oven control features high shock resistance with negligible contact noise. Accommodates HC-6/U crystal holder. Bulletin available.—*Manson Laboratories, Inc., Dept. M., P. O. Box* 594, 207 *Greenwich Ave., Stamford, Conn.*

For more information circle **150** on inquiry card.

TUNING FORK RESONATOR

Ruggedized to take vibration and 15 G 11-millisecond shock, new MJ series resonators will operate with either transistors or tubes. Available in frequencies from 400 to 2,200 cps, and in 0.01% overall accuracy ratings over −55° to 85°C. operating temperature range. Accuracies are unaffected while operating under rated vibration of 5.0 G to 40 cps, 0.060" displacement 40 to 55 cps, 2.0 G above 55 cps to 45% of fork frequency.—*Philamon Labs. Inc.*, 90 *Hopper St., Westbury, L. I., N. Y.*

For more information circle **151** on inquiry card.

WATERPROOF TRANSISTOR PREAMPLIFIER

New series of transistor preamplifiers developed for hydrophones and accelerometers have input impedance of 1 megohm and output impedance of 600 ohms. Equivalent input noise 10 μv, with 100 to 80,000 cps frequency response. Can be powered from internal mercury battery or external source, with local or remote control. Spec sheet available.—*Chesapeake Inst. Corp., Shadyside, Md.*

For more information circle **152** on inquiry card.

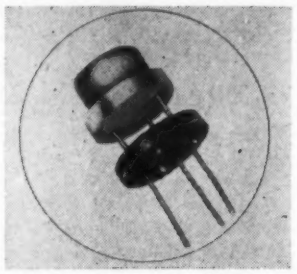
BREADBOARD TERMINAL KIT

New kit contains 8 basic types of stand-off and feed-thru Teflon-insulated terminals in a complete range of sizes for R & D construction; compartmented plastic case also contains insertion tools, instructions and prints. Terminals withstand high temperatures, shock, vibration, high frequency and corrosion; are easily pressed into position with insertion tool. No additional parts, soldering or fastening are needed.—*Taurus Corp.*, 8 *Coryell St., Lambertville, N. J.*

For more information circle **153** on inquiry card.

TRANSISTOR MOUNTING PAD

New device, called Transipad, is glass-filled Diallyl Phthalate wafer with 3 holes and 3 hemispherical feet. Jetec 30 transistor leads pass through



holes to circuit board solder connections. Transi-pad provides insulation and stable support to the transistor, also allows better air circulation around transistor and clearance for solder fillets.—*Milton Ross Metals Co., Davisville Rd., Bucks Co., Southampton, Pa.*

For more information circle **154** on inquiry card.

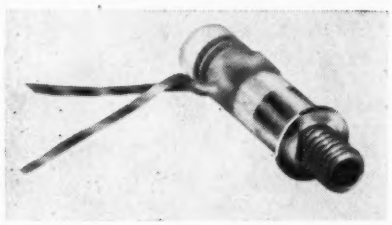
P-C MODULE FOR MISSILES

New printed circuit construction, called "Missile Module", is formed by two interlocked glass-epoxy boards forming a structural column in plus or cross shape, fitting into cylindrical or rectangular housing. Patent construction permits rugged mounting and reinforcement to withstand high vibration and shock, gives great circuit flexibility and excellent space factor.—*Arthur Ansley Mfg. Co., New Hope, Pa.*

For more information circle **155** on inquiry card.

L-C TUNER

New JFD L-C tuner winding, which also acts as capacitor plate, is metallized on a stable glass cylinder to provide a resonant circuit with high



stability, low temperature coefficient and smooth tuning adjustment. Movement of a piston in the cylinder changes both the inductance and capacitance. Performance characteristics can be varied to meet requirements by changing piston materials, by grounding the piston or by other types of loading.—*JFD Electronics Corp.*, 6101 16*th Ave., Brooklyn* 4, *N. Y.*

For more information circle **156** on inquiry card.

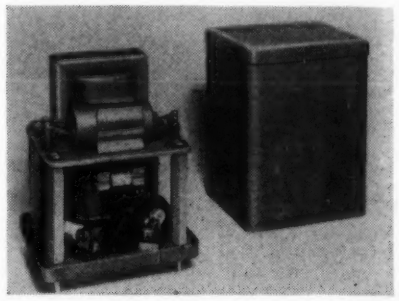
MINIATURE CO-AXIAL CONNECTORS

New TNC series small electrically matched coaxial connectors suitable for critical applications and extreme environments are impedance matched for 50-ohm cables such as RG-55A/U and RG-58C/U. Types are also available for RG-59/U, RG-62/U, RG-71/U and other small size cables. Contacts are gold plated with female and outer contacts fabricated of beryllium copper.—*Kings Electronics Co., Inc.*, 40 *Marbledale Rd., Tuckahoe, N. Y.*

For more information circle **157** on inquiry card.

TRANSISTORIZED AC-DC SUPPLIES

Direct-current outputs from 5 v to 28 v dc in ratings to 5 amperes, and from 100 v to 300 v dc in ratings to 400 ma are produced by a series of



transistorized ac-dc power supplies using 105-125 v ac, 60 cps or 400 cps sources. Each supply, whether designed for transistor, plate or filament power is small, compact and rugged, for reliable application in computers, missile circuitry, telemetering, or airborne electronic equipment.—*Universal Transistor Products Corp.*, 17 *Brooklyn Ave., Westbury, L. I., N. Y.*

For more information circle **158** on inquiry card.

HI-FREQUENCY AUTOMATIC V-R

Type IEH5101 Automatic Voltage Regulator meeting MIL-E-5400 maintains output voltage within ± 0.1% of any voltage selected, from 110 to 120 v for input voltage regulation from 95 to 130 v, and within ± 0.15% for load current and load factor changes. Maximum recovery time is 0.3 sec for complete correction of line or load changes.—*The Superior Electric Co., Dept. IEH, Bristol, Conn.*

For more information circle **159** on inquiry card.

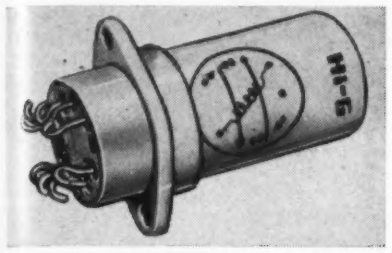
FREEZE-PROOF BATTERY

The Yardney Arctic, first cell to operate over −100°F to 200°F temperature range, is available to power radio equipment in arctic regions, unattended weather data instruments, equipment on exposed aircraft in polar regions and high altitude electronic equipment. New calcium-chloride cell has high terminal potential of about 2.3 v at −100°F. Hermetically sealed, and said to have no chemical deterioration, its shelf life is expected to be unlimited.—*Yardney Electric Corp.*, 40-50 *Leonard St., New York, N. Y.*

For more information circle **160** on inquiry card.

VIBRATION PROOF RELAYS

New 2-pole relay is offered on special order for applications needing two or three times normal vibration tolerance of 20 G at 2000 cps. Engineering assistance in selecting proper mounting and coil characteristics is available. Relays can be made to withstand temperatures to 200°C; contacts are rated at 5 amp resistive and for dry circuit applications.—*Robert Wood, Hi-G, Inc., Bradley Field, Windsor Locks, Conn.*



For more information circle **161** on inquiry card.

TRANSISTOR PANEL LIGHTS

New transistor-controlled indicator light, ½" dia, 2" long, is designated "Transistor-Lite". In same size is "Memo-lite" a thyratron indicator for transistor circuits, and "Echo-lite" a push button with neon light enclosed.—*Transistor Electronics Co,.* 3357 *Republic Ave., Minneapolis* 26, *Minn.*

For more information circle **162** on inquiry card.

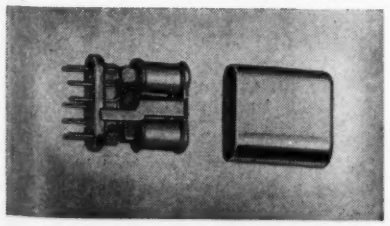
TRANSISTORIZED POWER INVERTER

New Model PS-3001 inverters provide 115 v ac at 400 cps for up to 750 ma loads, from input of 26 v dc ± 5%. Shape of output is square wave but filter for providing sine wave output is available. Hermetically sealed for operation in all environments and up to 85°C ambients. —*Power Sources, Inc., Burlington, Mass.*

For more information circle **163** on inquiry card.

MICRO-MINIATURE SEALED RELAY

New hermetically sealed continuous duty Series 1005 Guardian relay, DPDT, meets current requirements for all MIL Specs. Unit is completely "degassed" before sealing in nickel-silver can. Altitude tested to 80,000 ft; details on all environmental tests and characteristics are available upon inquiry.—*Guardian Electric Mfg. Co.,* 1621 *W. Walnut St., Chicago* 12, *Ill.*



For more information circle **164** on inquiry card.

TEFLON TEST POINTS, JACKS

Miniature test jacks, plugs, test points and breakaway connectors of one-piece construction feature Teflon in eight code colors for circuit identification, extra-strong holding power, high immunity to environmental conditions, and installation ease.—*Sealectro Corp.,* 610 *Fayette Ave., Mamaroneck, N. Y.*

For more information circle **165** on inquiry card.

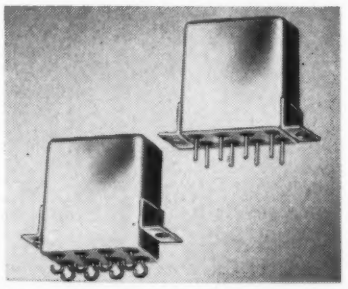
AIRBORNE POWER SUPPLY

New Model E-1A miniature airborne regulated power supply delivers a current of 0-400 ma at 300 v dc within ⅓% for either no-load to full-load variation or for input line-voltage variation from 105 to 125 v, 380 to 420 cps. Operates in ambients —65° to 85°C and to altitudes of 65,000 ft. Dimensions, 5⅝" x 5$\frac{15}{16}$" x 9" long; wt, 8½ lbs.—*Mercury Electronic Co., Box* 450, *Red Bank, N. J.*

For more information circle **166** on inquiry card.

SUBMINIATURE RELAYS FOR POWER AND LOW LEVEL SWITCHING

New DPDT Type FC-2 hermetically-sealed relays meet MIL-Specs for 30 G vibration at 2000 cps, 50 G Class II shock, and for —65° to 125°C ambients. Balanced rotary armature action and careful design of copper-to-iron in magnetic structure give maximum usable torque characteristics. Contacts are rated 2 amps resistive at 26.5 v dc and 115 v ac; are also suitable for low-level operation.—*Struthers-Dunn, Inc., Pitman, N. J.*



For more information circle **167** on inquiry card.

HI-TEMPERATURE POT

New Model HTC single-turn precision potentiometer designed for high temperature applications in ranges from 50 to 40,000 ohms, in linear or non-linear functions and with torque variations to 0.4 oz-in (min), to conform with customer specs. All component parts of this unit have been laboratory-tested to meet peak performance requirements at temperatures in excess of 225°C. Accuracy to ¼% in the 5000 to 40,000 ohm range, 50 mv (max) brush noise, and high resolution make this precision control unit suitable for many applications in military systems.—*Electromath Corp.,* 42-14 *Greenpoint Ave., Long Island City* 4, *N. Y.*

For more information circle **168** on inquiry card.

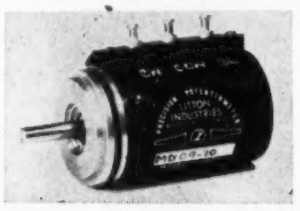
SEALED PRECISION POT

New rotary type MFR "Metlfilm" precision potentiometer, using an encapsulated deposited metal-on-film resistance unit, is hermetically sealed and environmentally tested for high reliability in missile use. Available in resistances from 1K to 50K, the manufacturer claims infinite resolution, operation to 145°C, less than 1 oz-in torque, no backlash and life of over 1-million cycles. Specifications brochure on request.—*Technology Inst. Corp.,* 531 *Main St., Acton, Mass.*

For more information circle **169** on inquiry card.

HIGHER PRECISION MINI-POT

New ⅞" dia multiturn miniature precision Model MS 09-10 potentiometer has independent linearity to ± 0.015% and resolution to 0.0085% guaranteed. Also feature a ceramic core, stainless steel bearings and a balanced rotor-slider assembly.—*Litton Industries, Components Div.,* 5873 *Rodeo Rd., Los Angeles* 16, *Calif.*



For more information circle **170** on inquiry card.

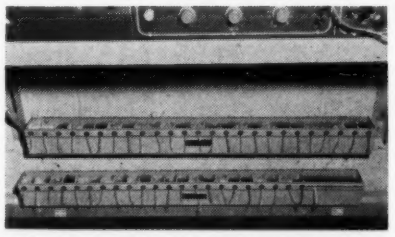
MICRO-MIN POTS EXTEND RANGE

Four new resistance values now make Aceset microminiature (½" dia) wire-wound precision potentiometers available in thirteen linear resistance values from 50 to 100,000 ohms. Heat dissipation 2 watts at 60°C; voltage breakdown of 1000 v dc; 325° electrical angle; resistance tolerance ± 10%; linearity ±5%.—*Ace Electronics Associates, Inc.,* 99 *Dover St., Somerville, Mass.*

For more information circle **171** on inquiry card.

WIRE SPOOL RACK

New wire spool racks for laboratories, maintenance departments and shops, feed assorted colored wire from 2⅝" or smaller spools through rubber grommets for ready use. Both racks are 34" long, one model holds 25 spools. Second model accommodates 22 wire spools and one spool of shielding cable.—*Gardner Lab. Inc., P. O. Box* 5728, *Bethesda* 14, *Md.*



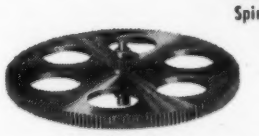
For more information circle **172** on inquiry card.

That's the story of Boehme Fine Pitch Precision Gears. Hobbed to meet requirements that include up to ⅛" x 5" O.D. — 180 — 16 D.P. AGMA Precision #3.

Spur Gear Clusters

Worm Wheels

Spiral Gears


Spur Gear Clusters

Quadruple Thread Worms

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you'll find a whole new concept of design and engineering skills backed by experienced craftsmanship in the production of electrical, electro-mechanical and electronic products for automation and instrumentation.

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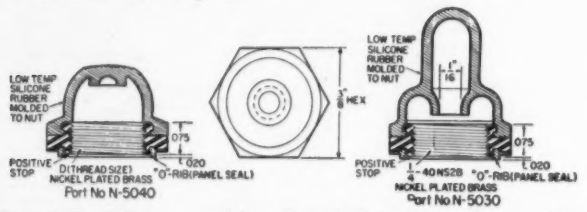
Designers and Manufacturers Communication Equipment Precision Electro-Mechanical Apparatus Since 1917

915 Broadway New York 10, N.Y.

For more information circle **33** on inquiry card.

Seals for Panel Switches

Hexseal series N-5000 are high-pressure seals for commercial or military subminiature toggle and push-button switches. When installed, the boots replace the switch lock-nut on the exterior of the panel, and serve as both seal and lock-nut. High pressure sealing is maintained by a gasket rib—an integral part of the boot—which seats firmly against any panel surface, regardless of finish, to keep out moisture, water, dust, or combustible vapors.



Material: Silicone rubber bonded to nut. Impervious to salt water, acids and ozone. These boots meet MIL-E-5272A and can be stored in any climate for more than 25 years without deterioration.
Temperature Range: Minus 160° to 500°F.
(*From new bulletin HEX-10, Automatic and Precision Mfg. Co., 252 Hawthorne Ave, Yonkers, N. Y.*)

For this literature circle **173** on inquiry card.

"Debugging" Increases Capacitor Reliability

Silvered mica capacitors have a decreasing failure rate with time. After an initial period, during which failures occur more rapidly, there is a levelling off in the failure curve (Fig. 1). "Debugging" can be defined as the removal of early failures by means of a short life test at elevated voltage and temperature.

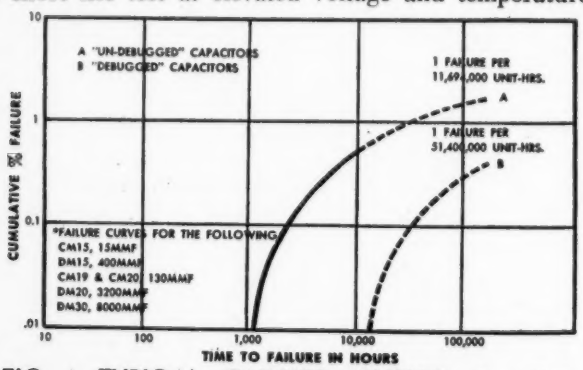


FIG. 1. TYPICAL FAILURE CURVES for "undebugged" and "debugged" silvered mica capacitors when tested at 85°C with 100% rated dc voltage (500 v) applied.

When DM dipped mica and CM molded mica capacitors are to be used in high reliability units at 85°C they should be "debugged" at 125°C. This removes approximately 80% of the failures that would occur in a 10,000 hr period at 85°C with 150% of rated dc voltage applied. Similarly, capacitors that are to be used at 125°C should be "debugged" at 150°C to achieve a comparable reduction in failures. (*From 6-page brochure, "Reliability Study of Silvered Mica Capacitors," The Electro Motive Mfg. Co., Inc., Williamantic, Conn.*)

For this literature circle **174** on inquiry card.

MINI LOW-TORQUE POT

New Model R-6 low-torque high-speed precision potentiometer used in military fuel gauge systems is available for other jobs where its 0.2 oz-in torque and independent linearity of 0.5% is applicable. Case is ⅝" dia x 21/32" long; resistances of 1K, 2K, 5K and 10K are standard with up to 100K available on order.—*Precision Line Inc., 63 Main St., Maynard, Mass.*

For more information circle **175** on inquiry card.

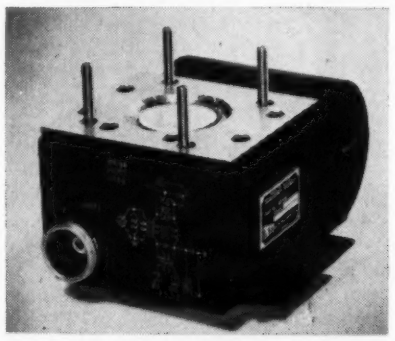
SINE-COSINE PRECISION POT

New type WPSC 1-⅛ non-linear sine-cosine precision potentiometer provides two accurate and entirely separate 360° sinusoidal voltage outputs displaced 90° in phase. Particularly useful in radar PPI displays, various types of computers, etc.; optional features provide ball bearings, tapped hole mounting, bushing mounting, and ganging up to four cups.—*Waters Mfg., Inc., Wayland, Mass.*

For more information circle **176** on inquiry card.

MAGNETRON PULSE TRANSFORMER

New pulse transformer assembly, NYT-40200, designed to directly mount 4J52 and 6543 magnetrons, also contains isolation and filament



transformers for magnetron, RF line filter, pulse-current metering circuit, and bypass capacitors. Delivers 15,000 v pulses, 0.3 to 3.2 μsec long; it also safely handles misfiring pulses to 40,000 v. Oil-filled and bellows compensated, it operates in ambients of −55° to 125°C.—*New York Transformer Co., Inc., Alpha, N. J.*

For more information circle **177** on inquiry card.

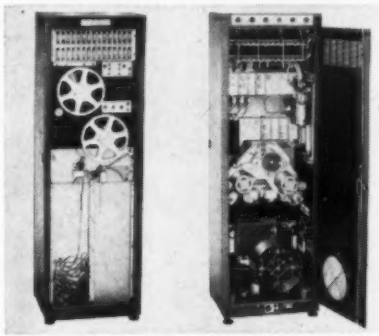
VERSATILE MAGNETIC TAPE SPLICER

New combination Model 300.1 butt-weld and overlap splicer for any type magnetic tape handles any width to 2¾". Prestoseal butt-weld method uses no adhesives; overlap splicer is flat on the oxide side to minimize head wear. Either mylar or acetate tapes used for sound, video, or data recording can be accurately spliced. Operates from 110/220 v ac, 50/60 cps source.—*Prestoseal Corp., 37-27 33rd St., Long Island City, 1, N. Y.*

For more information circle **178** on inquiry card.

TRANSISTORIZED TAPE TRANSPORT

New Model 424 fully-transistorized tape transport system uses two independent capstan drives with start-stop times of less than 2 ms to obtain

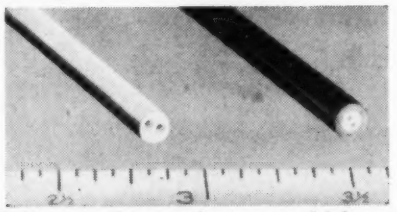


tape operation in either direction at speeds from 7½ ips to 150 ips. Tape widths from ¼" to 2", storage bins for 3000" of tape and modular construction with moderate power dissipation application.—*D. G. C. Hare Co., 30 Burtis Ave., Canaan, Conn.*

For more information circle **179** on inquiry card.

CRUSHABLE ALUMINA INSULATES ELEMENT WIRES

A new technique, used for insulating metal-cased low-temperature heating elements and thermocouples in jet engine and missile applications, strings crushable alumina beads

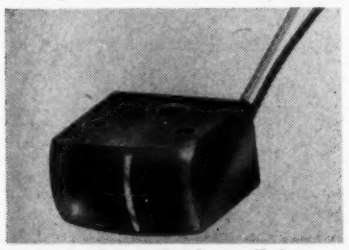


(left) on the conductors, which are then slipped into a close-fitting metal tube. The entire assembly is then swaged to the desired size (right) reducing the alumina to powder. This method compacts the insulation without damaging or displacing the wire, producing a flexible element or couple which is unaffected by vibration.—*McDanel Refractory Porcelain Co., Beaver Falls, Pa.*

For more informatoin circle **180** on inquiry card.

ERASE HEAD

New magnetic tape dc erase head providing 50 db erasure with 5.5 ma

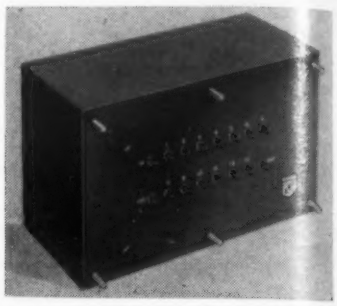


of current through the coil has a 20-mil track-width configuration. A mating playback-record head will be announced shortly.—*Michigan Magnetics, Inc., Vermontville, Mich.*

For more information circle **181** on inquiry card.

DELAY-TO-RISE-TIME TRIPLED

New extended band-width lumped constant delay line is said to triple delay-to-rise time ratio previously available with any line, enabling

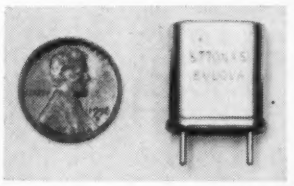


computer engineers to design delay line memories with 72-bit storage capacities rather than 25. Also provides wider bandwidth for handling closely-spaced pulse groups without additional circuitry to endanger reliability. Temperature coefficient of delay is less than 65 ppm/°C.—*ESC Corp., 534 Bergen Blvd., Palisades Park, N. J.*

For more information circle **182** on inquiry card.

MISSILE CRYSTALS

New frequency stabilizer for missile electronics is Bulova's crystal, ST-70NXS, said to be smallest unit

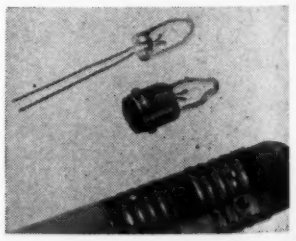


of its type. Frequencies of 100-250 kc are held to ± 0.015% over a −55° to 90°C range. Meet or surpass all environmental Mil specs, including vibration of 20 G to 2000 cps.—*Bulova Watch Co., Electronics Div. P-1059, Woodside 77, N. Y.*

For more information circle **183** on inquiry card.

SUB-MINIATURE LAMP

New lamp originally designed with approximately 7 years of life at 5 v for integrally-lighted aircraft in-



struments, will withstand voltage surges to 30 v. Extremely rugged and impervious to vibration damage, it appears to have a great future in providing light which will outlast almost any instrument or equipment it lights.—*Chicago Miniature Lamp Works, 1500 N. Ogden Ave., Chicago 10, Ill.*

For more information circle **184** on inquiry card.

New Literature

ELECTRONIC COMPONENTS

VERNISTAT PRINCIPLE is explained in new 4-page Model 2B bulletin.—Vernistat Div., Perkin-Elmer Corp., Norwalk, Conn.
Circle **185** on inquiry card.

PRECISION POTENTIOMETERS in single and multi-turn designs are technically described in new 16-page file folder.—Electromath Corp., 42-14 Greenpoint Ave., Long Island City 4, N. Y.
Circle **186** on inquiry card

POTENTIOMETER TRANSDUCER terms are defined in new 2-page bulletin IDEF/B/8.—Instrument Sales Div., Bourns Labs., Inc., Box 2112, Riverside, Calif.
Circle **187** on inquiry card

TANTALUM CAPACITOR type 160D, designed for hearing-aid applications is described in Eng. Bulletin 3515, giving technical advantages of low-cost solid-electrolyte capacitor.—Tech. Lit. Section, Sprague Electric Co., 43 Marshall St., North Adams, Mass.
Circle **188** on inquiry card

SUBMINIATURE CERAMIC CAPACITORS of all types and styles are listed in new data bulletin H-1.—Mucon Corp., 9 St. Francis St., Newark 5, N. J.
Circle **189** on inquiry card

ENAMEL DIELECTRIC CAPACITORS, specs, test data and applications are discussed in new 4-page brochure.—Vitramon, Inc., P.O. Box 544, Bridgeport 1, Conn.
Circle **190** on inquiry card

PRECISION WIRE-WOUND resistors are subject of new 20-page catalog 14RC.—Cinema Engineering, 1100 Chestnut St., Burbank, Calif.
Circle **191** on inquiry card

READ AND RECORD HEADS for magnetic drums in airborne data-handling systems etc., are explained in new 4-page bulletin E200.—Librascope, Inc., 40 E. Verdugo Ave., Burbank, Calif.
Circle **192** on inquiry card

TELEMETERING miniature high-speed rotary switch specifications are given in new 2-page technical bulletin.—Instrument Development Laboratories, Inc., 67 Mechanic St., Attleboro, Mass.
Circle **193** on inquiry card

COMPUTER DESIGN using general-purpose digital building blocks is described in new 10-page brochure, "A Systematic Approach to Electronic Digital Equipment Design."—Control Data Corp., 501 Park Ave., Minneapolis 4, Minn.
Circle **194** on inquiry card

PHYSICIST'S GRID is approximated in new type 6688 tube designed for exacting circuits. Design possibilities are illustrated by radar IF amplifier circuit in new 12-page brochure, "Amperex 'PQ' Reliable Frame Grid Tubes."—Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L. I., N. Y.
Circle **195** on inquiry card

GERMANIUM and **SILICON** transistor plug-in circuits for computer building blocks, etc., are described in new Application and Catalog data brochure.—Engineered Electronics Co., 506 E. First St., Santa Ana, Calif.
Circle **196** on inquiry card

HIGH TEMPERATURE CERAMICS for sealing to glass, Vacuum-furnace crucibles, pyrometric insulation, etc, are listed in new 16-page catalog.—McDanel Refractory Porcelain Co., Beaver Falls, Pa.
Circle **197** on inquiry card

MILITARY SWITCHES featuring positive action and highest reliability are described in new 16-page booklet EA-168.—Cutler-Hammer Inc., 503 N. 12 St., Milwaukee 1, Wisc.
Circle **198** on inquiry card

400 CYCLE TRANSFORMERS hermetically sealed in Mil-standard cases are described in new data sheet CT-40.—Chicago Standard Transformer Corp., 3501 W. Addison St., Chicago 18, Ill.
Circle **199** on inquiry card

INSTRUMENTS TEST EQUIPMENT

TRANSISTOR forward current and back current testers are explained in new technical data sheet FT1-BT1.—Trans Electronics, Inc., 7349 Canoga Ave., Canoga Park, Calif.
Circle **200** on inquiry card

TELEMETERING AND TEST equipment etc., are explained in new bulletins, RAD 100 series.—Radiation Inc., P. O. Box 37, Melbourne, Fla.
Circle **201** on inquiry card

PRECISION MEASURING FOR MISSILE PRODUCTION is title of new brochure, describing precision gages.—Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Circle **202** on inquiry card

A-F SUB-CARRIER EQUIPMENT for transmission of TTY over communication circuits is discussed with specs in new 4-page engineering bulletin #57.—Rixon Electronics Inc., 2414 Reedie Drive, Silver Spring, Md.
Circle **203** on inquiry card

MULTI-PURPOSE ELECTROMETER #610 measures dc voltage, current and resistance over extremely broad ranges. Specs given in 4-page Engineering Notes vol 6 no. 1.—Keithley Instruments, Inc., 12415 Euclid Ave., Cleveland 6, Ohio.
Circle **204** on inquiry card.

AVIATION DEVELOPMENT AND TEST equipment is discussed in new 8-page booklet B-7269.—Westinghouse Electric Corp., P.O. Box 2099, Pittsburgh 30, Pa.
Circle **205** on inquiry card

TEST EQUIPMENT FANS and blowers operating from supply frequencies from 45 to 600 cps without switching are described in new 2-page bulletin RM-220.—Rotron Mfg. Co., Inc., Schoonmaker Lane, Woodstock, N. Y.
Circle **206** on inquiry card

SERVOS, ACTUATORS POWER SUPPLIES

SERVOMOTOR model 8 SM 420 is subject of new 4-page data sheet #1366.—Beckman/Helipot Corp., Newport Beach, Calif.
Circle **207** on inquiry card

HYDRAULIC SERVO DRIVES for weapons systems are described in new 12-page bulletin AI-5801.—Vickers Inc., Detroit 32, Mich.
Circle **208** on inquiry card

MINIATURE MOTORIZED DEVICES, incl. instrument panel vibrators, dc generators, gear reducers, clutches, rate gyros, actuators, timers, etc. are described in new 20-page catalog.—Globe Industries, Inc., 1784 Stanley Ave., Dayton 4, Ohio.
Circle **209** on inquiry card

AUTOMATIC VOLTAGE REGULATORS, ¼ to 10 kva, are described in new 12-page bulletin S3581E.—The Superior Electric Co., Bristol, Conn.
Circle **210** on inquiry card

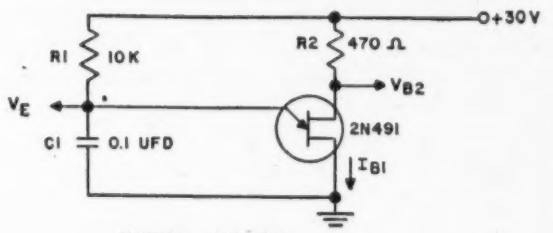
HYDRAULIC PUMP, 64W1000 Overcenter, for airborne applications to 3000 psi and speeds to 4500 rpm is described in new 16-page brochure.—Watertown Div., The New York Air Brake Co., Starbuck Ave., Watertown, N. Y.
Circle **211** on inquiry card

HYDRAULIC SERVO DRIVE packages for weapons systems developed in past 20 years are treated in new 12-page facilities booklet.—Vickers, Inc., Detroit 32, Mich.
Circle **212** on inquiry card

AIRBORNE ACTUATORS, gearing, housings, etc. are described in new 152-page catalog. Equipment is designed to meet MIL-M-8609, -E-5252A, -A-8064A and -I-6181A.—Hoover Electric Co., 2100 S. Stoner Ave., Los Angeles 25, Calif.
Circle **213** on inquiry card

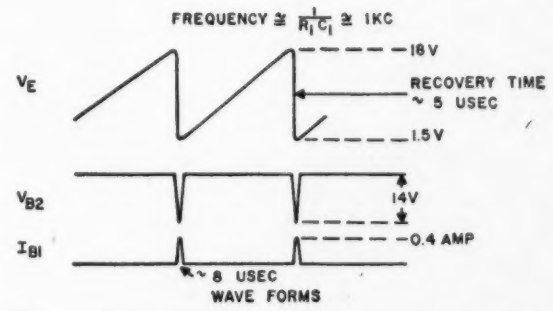
Unijunction Transistor Application

The Silicon Unijunction Transistor consists of an "N" type silicon bar mounted between two ohmic base contacts with a "P" type emitter near base-two. This device is useful in medium power switching and oscillator applications, where it can serve the purpose of two conventional silicon transistors.



TYPICAL CIRCUIT

The Relaxation Oscillator is a basic circuit (see illustration) having applications in sawtooth generators, pulse generators, pulse rate modulators, and frequency dividers. Repetition rates of less than one cycle per minute to several hundred kilocycles per second are possible. The upper limit of frequency is given in the specifications as the maximum frequency of oscillation, f_{MAX}. As this frequency is approached, the current and voltage waveforms degenerate into sine waves and the amplitude are considerably decreased. The lower limit in frequency is determined by the leakage current of the emitter and the minimum current required for triggering (Peak Point Emitter Current).



WAVE FORMS

High voltage negative pulses may be obtained across the resistor (R_2) in the base-two circuit. Low voltage positive or negative pulses at low impedance levels may be obtained across resistors between base-one and ground or C_1 and ground respectively.

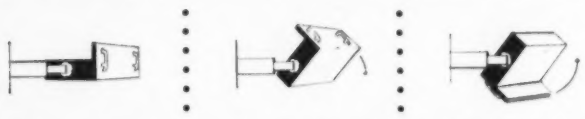
The current pulse width, t_i, and the emitter voltage recovery time, t_{ve}, are determined primarily by the size of the capacitor C_1. (*Application is given in full with fifteen other applications in two new brochures, GP-176, Semiconductor Products Dept., General Electric Co., Syracuse, N. Y.*)

For this literature circle **214** on inquiry card.

FOR MORE INFORMATON ON ANY OF THE PRODUCTS REPORTED OR ADVERTISED IN THIS ISSUE, CIRCLE THE ITEM NUMBER ON THE INQUIRY CARD BOUND IN THIS ISSUE.

Chassis Slide Design Aids Military Equipment Maintenance

Positive Tilt-Lock detent secures chassis in seven different service positions—45°, 90° and 105° up or down, as well as horizontal. Makes it easy for the serviceman to see and work on any part, even tube sections of equipment installed above normal eye level. Positive "out" lock feature is particularly advantageous under vibration conditions on ships, aircraft, etc. Push button releases chassis for return to cabinet.



Fast chassis removal is effected by finger spring mechanism, gets chassis out of cabinet and onto service bench in seconds. All Chassis-Trak slides are now cadmium plated without additional charge on custom orders for military applications.

(*From* 4-*page bulletin D*-151*B*, *Chassis-Trak, Inc.*, 525 *S. Webster Ave., Indianapolis* 19, *Ind.*)

For this literature circle **215** on inquiry card.

Open Type Ball Bushings for Supported Shafts

Open type Ball Bushings have a longitudinal section removed from their circumference to permit the use of shaft support members along the shaft which they traverse. The standard open type has an open sector equal to one ball circuit. The width of the open sector can be increased on special orders by omitting additional ball circuits.

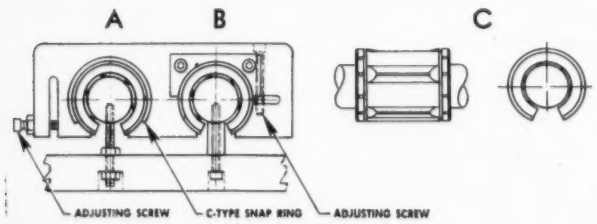


FIG. 1. OPEN-TYPE BALL BUSHINGS permit rigid support of shaft. (A) Stud-type mount; (B) pillar-type mount; (C) Ball Bushing detail.

This construction eliminates shaft deflection and is recommended where extreme rigidity or unusually long shafts are required. Compensation for any wear which may develop in severe applications is also permitted. In addition to the economies of using centerless ground round shafts for ways, the low friction, lasting alignment and freedom from chatter of Ball Bushings are important considerations in machine design. The provision for adjusting for zero shake or play and for possible subsequent wear is also important and is being used by alert designers who formerly had to use plain sliding flat- or V-ways. (*From* 25-*page catalog installation guide No.* 4, *Ball Bushings, Thomson Industries, Inc., Manhasset, N. Y.*)

For this literature circle **216** on inquiry card.

SOLID STATE TRANSDUCERS, load cells and pressure resistors are described in new 4-page bulletin #285.—Clark Electronic Labs. Research Products Div., Box 165, Palm Springs Calif.

Circle **217** on inquiry card

SERVO ACTUATORS, series 3050 and 3064, for actuation of hypersonic flight control surfaces, are explained in new data sheets 111-8 and 111-9.—Lear, Grand Rapids Div., 110 Ionia Ave., N. W., Grand Rapids 2, Mich.

Circle **218** on inquiry card

FACILITIES & ENVIRONMENTAL TESTS

ASTRONAUTICAL PRODUCTS, research and development, are described in new 16-page facilities brochure, "Leader on a New Frontier".—Dept. FW-A109, The Firewel Co., Inc., 3685 Broadway, Buffalo 25, N. Y.

Circle **219** on inquiry card

RESEARCH in space technology, plasma dynamics and hypersonics is described in new 18-page facilities brochure.—Missile and Ordnance Systems Dept., Room 5A, General Electric Co., 3198 Chestnut St., Philadelphia 4, Pa.

Circle **220** on inquiry card

FACILITIES for research, design, development and production of aircraft and missile subsystems and components are described in new 16-page bulletin 2100.—Leland Electric Co., Div. American Machine & Foundry Co., P. O. Box 1060, Dayton 1, Ohio.

Circle **221** on inquiry card

ELECTRONIC CONTROL subsystems and components are described in new 28-page facilities catalog.—Electronics Div., Thompson Products Inc. 2196 Clarkwood Rd., Cleveland 3, Ohio.

Circle **222** on inquiry card

MISSILE TEST and Support Equipment is described in new 4-page bulletin.—George L. Nankervis Co., 15300 Fullerton Ave., Detroit 27, Mich.

Circle **223** on inquiry card

ENVIRONMENTAL TEST CHAMBERS are illustrated in new 4-page specification brochure.—International Test Equipment Mfg. Co., Inc., P. O. Box 191, Port Washington, N. Y.

Circle **224** on inquiry card

MICROWAVE ASSEMBLIES and facilities available for their development and production are described in new 12-page facilities brochure.—Budd-Stanley Co., 43-01 22nd St., Long Island City 1, N. Y.

Circle **225** on inquiry card

FACILITIES BROCHURE summarizes projects, services and capabilities.—Avco Research and Development Div., 20 South Union St., Lawrence, Mass.

Circle **226** on inquiry card

HUMAN CENTRIFUGE, missile launchers, sonar mechanisms and specialized production equipment built by McKiernan-Terry are featured in new 32-page facilities brochure.—McKiernan-Terry Corp., Dover, N. J.

Circle **227** on inquiry card

NUCLEAR instruments for research and industrial control are described in new 12-page folder.—Hamner Electronics Co., Inc., P. O. Box 531, Princeton, N. J.

Circle **228** on inquiry card

CABLES, CONNECTORS

MINIATURE CONNECTOR specifications and descriptions are subject of new 40-page catalog.—Continental Connector Corp., Woodside 77, N. Y.

Circle **229** on inquiry card

OXYGEN-FREE, TEFLON Insulated cables for high temperature missile applications are described in new OF-HC cable bulletin.—Aero-Marine Development Corp., Chatham, N. J.

Circle **230** on inquiry card

MINIATURE METAL BELLOWS for use in miniaturizing bellows-using systems are explained in new 2-page bulletin.—Servometer Corp., P. O. Box 42, Clifton, N. J.

Circle **231** on inquiry card

AIRBORNE POWER SUPPLY using silicon rectifiers is illustrated and described in new 2-page bulletin GEC-1495.—General Electric Co., Schenectady 5, N. Y.

Circle **232** on inquiry card

SOLID-BLOCK TERMINAL BOARDS, series 440 and 441, are described in new 4-page bulletin GP-2-358.—General Products Corp., Union Springs, N. Y.

Circle **233** on inquiry card

JUNCTION-TERMINAL BUSHINGS for use as chassis jack or plug-in receptacle replacing permanently attached "pigtails" are described in 2-page brochure.—Heyman Mfg. Co., Kenilworth, N. J.

Circle **234** on inquiry card

MISCELLANEOUS

SOLDERING MACHINE eliminating cold solder joints and incorporating adjustable temperature control and timer is described in new bulletin.—Virginia Electronics Co. Inc., River Rd. and B. & O. Railroad, Washington 16, D. C.

Circle **235** on inquiry card

BIMETAL DISC THERMOSTATS for use in missiles aviation and electronic equipments are described in new 2-page bulletin 6100.—Stevens Mfg. Co., Inc., P.O. Box 1007, Mansfield, Ohio.

Circle **236** on inquiry card

NEW COOLING TECHNIQUES for missile and airborne electronic circuits are described with graphs, thermal equations, in 10-page report on "Heat Exchange System Design" by Behning and Jacob.—United Aircraft Prod., Inc., Box 1035, Dayton, Ohio.

Circle **237** on inquiry card

EXPLOSIVE POWER COMPONENTS and actuators are described in new 4-page Form PEP-4-658.—Holex Inc., San Juan Rd., Hollister, Calif.

Circle **238** on inquiry card

GOVERNMENT SPECIFICATIONS on adhesives, coatings and sealers are listed by number with 3M product that meets each specification, in new 23-page catalog.—Minnesota Mining & Mfg. Co., 423 Piquette Ave., Detroit 2, Mich.

Circle **239** on inquiry card

WALLET SIZE altitude pressure table gives equivalent in millimeters of mercury for range of altitudes from sea level to 2,000,000'.—Vacuum Equipment Div., F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.

Circle **240** on inquiry card

WALL CHART showing data for standard resin applications, also shows information about mechanical proportioning dispenser for handling resins, plastic surface coatings, adhesives, cements and sealants.—Emerson & Cuming, Inc., 869 Washington St., Canton, Mass.

Circle **241** on inquiry card

HIGH RELIABILITY a Dynamic Standard, is the subject of new 16-page free booklet.—Standard Pressed Steel Co., Jenkintown, Pa.

Circle **242** on inquiry card

STATIC-MAGNETIC control of new Panalarm annunciators is described in new 4-page bulletin No. 101.—Panellit Inc., 7401 N. Hamlin Ave., Skokie, Ill.

Circle **243** on inquiry card

CHASSIS, CABINET and relay racks stocked by Bud distributors are listed by styles, finishes and dimensions on handy sliderule type Slide-chart for design engineers.—Bud Radio, Inc., 2118 E. 55 St., Cleveland 3, Ohio.

Circle **244** on inquiry card

VIBRATION CONTROL MOUNTINGS for protection of airborne electronic equipment are described in new 8-page bulletin #301.—Lord Mfg. Co., Erie, Penna.

Circle **245** on inquiry card

ELECTRICAL CONTACTS for projection welding are featured in new 4-page technical bulletin #501.—Gibson Electric Co., Box 501, Delmont, Penna.

Circle **246** on inquiry card

GYRO MOUNTS with torsion bars to protect gyroscopic instruments from vibration and shock are described in new 2-page data sheet #581.—Federal Shock Mount Corp., Div. of Korfund Co., Inc., 1060 Washington Ave., New York 56, N. Y.

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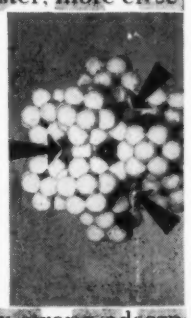
Chemical-Loaded Molecular Sieves— Latent Curing Aids in Rubber and Plastics

Rubber and plastics fabricators need faster curing systems. The use of more active agents for rapid curing reactions has been restricted, because their use generally results in formulations difficult to process and store. This problem is serious at the high temperatures reached during the processing of rubber formulations. A novel series of latent curing aids, called LINDE Chemical-Loaded Molecular Sieves, now make it possible to use these active compounds to obtain faster, more effective curing systems, while still maintaining processing safety.



In LINDE Chemical-Loaded Molecular Sieves curing aids are "locked" within the pore structure of the Molecular Sieves by strong adsorptive forces. The active compounds, when loaded on Molecular Sieves, are effectively isolated from the rubber or resin formulation during processing and storage. However, at curing temperatures, which are generally higher than processing temperatures, the active compound is released from the Molecular Sieve to accelerate the curing reaction.

In this way, Loaded Molecular Sieves permit the use of highly active compounds to obtain fast cures, without sacrificing processing safety or pot life. Now, even vulcanization agents previously considered too active or volatile for practical use, may be used with processing safety.

Chemical-Loaded Molecular Sieves can be used as latent accelerators and curing agents in a variety of rubber and plastics formulations including styrene-butadiene rubber, natural rubber, Neoprene, nitrile rubber, epoxy resins, rigid vinyl plastisols and others. Loaded Molecular Sieve CW-2015 (di-tertiary butyl peroxide) is being used commercially in the curing of silicone elastomers and rigid vinyl plastisols. Loaded Molecular Sieves are now being investigated by many processors of rubber and plastics in such items as tires, mechanical goods, hose, belting and footwear. For further data, write to Molecular Sieves Department MA-8, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y.

Radioactive Krypton

Krypton 85 is a radioactive isotope of the inert atmospheric gas, with a half-life of 9.4 years.

Radioisotopes such as Kr-85 are relatively inexpensive and new uses for them are being found every day.

One application is in tracer element testing of hermetically sealed encapsulated transistor devices. Another is in an "external" non-electric illuminating lamp which uses Kr-85 to activate a phosphor coating on the inside of a glass globe. Studies at the National Institutes of Health have shown that Kr-85 can be used to detect abnormal heart openings. 99 per cent of Kr-85 radiation is non-penetrating, quite safe, even for repeated exposures.

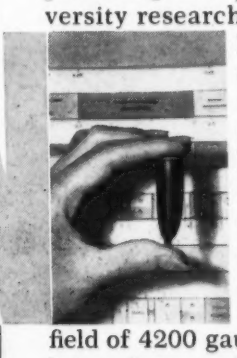
LINDE is marketing Kr-85 as an additive to non-radioactive rare gases (argon, helium, neon, krypton and xenon) individually or as mixtures. LINDE does not sell Kr-85 in pure or concentrated form. The other rare or inert gases, with Kr-85 added, will normally be available only in Atomic Energy Commission-approved, specially-marked cylinders.

Purchasers must be licensed by local or regional A.E.C. offices except for purchases of one microcurie or less. Non-licensed purchasers of one microcurie each may have 10 such cylinders on hand at a time.

LINDE's price for Kr-85 additions will be based on the radioactive level of the gas mixture expressed in millicuries of activity (N.T.P.) per liter. For additional information, write to Rare Gas Department MA-8, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y.

Three-Level Ruby Maser

The Maser is a microwave amplifier utilizing energy stored in a molecular or atomic system. Emission of this energy is stimulated by the input signal. Masers operate at liquid helium temperatures and have incredibly low noise levels approaching zero db. Recently a University research laboratory* used



LINDE single crystal synthetic ruby (Al_2O_3 with Cr_2O_3 additive) in a three-level solid state Maser. The ruby crystal was placed at the center of the Maser's tuned cavity and a magnetic field of 4200 gauss was applied. To bring electrons from a ground state into a permissible higher energy level, a pumping frequency of 24 kMc was used and the Maser successfully amplified signals at 9.3 kMc.

LINDE also supplies other crystals including rutile, spinel and sapphire (Al_2O_3). Sapphire is used in infrared optical systems, windows for high power microwave tubes, spacers and supports in vacuum tubes, radiation pipes. It has strength at elevated temperatures, melts at 2040°C, is hard, inert, nonporous and can be sealed to metals and glasses. Sapphire is currently available in the shape of domes, windows up to 4½ inches in diameter, rods and special configurations.

For further data write to Crystal Products Department MA-8, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, New York.

*"Maser Action in Ruby," by G. Makhov, C. Kikuchi, J. Lambe, and R. W. Terhune. "Physical Review," Volume 109, Number 4, Page 1399, Feb. 15, 1958.

PRODUCTS WITH A FUTURE

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For more information on Three-Level Ruby Maser circle **36** on inquiry card.

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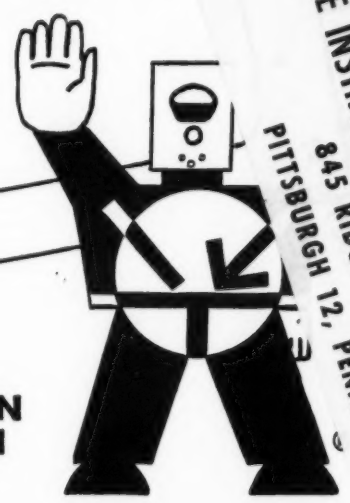

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Input: 105-125 volts, 55-440 cycles; Silicon diode references and rectifiers; Measures 5¾" x 8¼" x 9"; Modular package construction suitable for multi unit rack mounting.

* U.S. Patent Applied For

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Accepted as Controlled Circulation Publication at Pontiac, Illinois

M/A EVENTS

…mber 22-24—Telemetry Group Sym… IRE, Americana Hotel, Bal Harbour… Beach, Fla., Write Conrad Hoeppner… …n, Inc., Melbourne, Fla.

…er 24-25—7th Annual Symposium … Electronics of the IRE, Rackham … Auditorium, Detroit, Mich., Write … urston, IRE Prof. Grp. on Indust. … …ics, General Radio Co., 275 Massa… …husetts Ave., Cambridge 39, Mass.

September 30-October 2—4th Annual Joint Military-Industry Packaging and Handling Symposium. Write Office of Naval Material, Navy Department, Washington 25, D. C.

October 13-15—1958 National Electronics Conference—14th Annual Forum on Electronic Research, Development and Application; sponsored by AIEE, IRE, Ill. Inst. of Tech., Northwestern U. and Illinois U. at Hotel Sherman, Chicago. Write Nat. Electronics Conference publicity chairman c/p Illinois Bell Telephone Co., 208 W. Washington St., Chicago 6, Ill.

October 27-28—5th Annual East Coast Conference on Aeronautical and Navigational Electronics. Write W. A. Scanga, Aircraft Armaments, Inc., Cockeysville, Md.

November 3-7—5th Institute on Electronics in Management, The American University, Washington, D. C. Write Lowell H. Hattery, Institute Director, American University, 1901 F St. N.W., Washington 6, D. C.

November 10-13—Space Conference, School of Aviation Medicine, USAF; and Southwest Research Institute, San Antonio, Tex., Write Jack Harmon, Box 2296, San Antonio 6, Texas.